

FINAL
DATA REPORT No. 1

**THE XBT PORTION
OF THE OPERATING PROGRAM
FOR THE
106-MILE SITE**

**EPA Contract No. 68-C8-0105
Work Assignment 3-7**

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1.0 BACKGROUND

The 106-Mile Deepwater Municipal Sludge Site (106-Mile Site) has been used for sewage sludge disposal since 1986. The volume of sludge dumped annually at the 106-Mile Site is relatively well known due to the Environmental Protection Agency (EPA) requirement that all permittees submit a record of each dumping operation (e.g., time, date, position, sludge volume, dumping rate, etc.) within 1 month following each event. Approximately eight to nine million wet tons per year will be dumped during 1990 by the six New Jersey and three New York sewerage authorities that use the 106-Mile Site.

Evaluation of sludge disposal and of the fate and effects of sludge dumped at the 106-Mile Site has been conducted since 1986 under a monitoring plan developed and implemented by the EPA (Battelle, 1988). Recently, as required by the Ocean Dumping Ban Act of 1988 (ODBA), a new 106-Mile Site Monitoring Plan (Battelle, 1990a) was developed jointly by EPA, the National Oceanic and Atmospheric Administration (NOAA), and the United States Coast Guard (USCG). This EPA/NOAA/USCG plan, which supersedes the EPA monitoring plan, is being implemented to determine the transport and fate of municipal sludge dumped at the 106-Mile Site. The joint monitoring plan consists of four tiers that are similar to those described in the previous EPA Monitoring Plan (Battelle, 1988). Tier 1 describes monitoring of waste characteristics and disposal operations; Tier 2 focuses on the nearfield fate and short-term effects, whereas Tiers 3 and 4 address farfield fate and long-term effects, respectively (Battelle, 1990b).

Tier 2 of the monitoring program entails field measurements and laboratory analyses to determine the nearfield fate of sludge dumped at the 106-Mile Site. These activities include field measurements such as sludge plume dispersion, laboratory analyses of trace metals, organics, and microbiology of water samples collected from sludge plumes, and oceanographic and meteorological measurements at the site, using a moored instrumentation system.

Tier 3 of the monitoring program focuses on the transport of sludge away from the 106-Mile Site. The governing factors affecting the farfield transport of sludge are (1) the time-varying localized release of sludge, the source function, (2) the settling characteristics of the various sludge particle fractions, and (3) the time-varying three-dimensional field of currents that affects the advection and dispersion of the sludge as it sinks through the water column. This particular work assignment (WA 1-07) contributes directly to the third element of Tier 3 by providing for the receipt and compilation of hydrographic data (temperature profiles) from a transect conducted in the vicinity of the site by NOAA.

2.0 WORK ASSIGNMENT OBJECTIVES

The objectives of this report are to collect and present results of temperature measurements offshore of the shelf break along a line extending from New York to Bermuda during the period from March 1990 through August 1990. Data from transects conducted after August 1990 will be submitted in additional reports to be prepared in FY 91. As part of other activities, these observations will be combined with other data taken in the general study area to develop an improved understanding of the farfield circulation and transport processes.

3.0 METHODS

Vertical temperature profiles were measured periodically along the cruise track of the M/V *Oleander*. The temperatures presented in this report were measured with expendable bathythermographs (XBT) that provide temperature information down to approximately 460 m depth. The along-track sampling interval is determined by the speed of the vessel since generally one probe is released approximately every hour for the region between approximately the shelf break and the north (cold) wall of the Gulf Stream. A representative example of a cruise track is given in Figure 1.

As shown in Table 1, the 18 transects presented here begin in March 1990 (Cruise 90-03) and extend through the latter portion of August 1990 (Cruise 90-21). Typically, between 21 and 25 XBTs were dropped on a given transect. The Appendix provides a listing of the latitude and longitude for each station on each cruise.

4.0 DATA PRODUCTS

For each transect, four graphic products have been created by the NOAA Atlantic Environmental Group in Narragansett, Rhode Island. These data are also submitted by this group to the NOAA/National Oceanic Data Center for centralized archiving, access, and management. Examples of each data product are given in Figures 1 and 2(a-c). In Figures 2(a-c), the horizontal axis is the along-track distance in kilometers. Figure 1 shows the cruise track and station locations. Figure 2(a) shows the surface temperature and salinity as determined from surface water samples at each indicated station. Figure 2(b) shows a vertical section on which isotherms of integer values of temperature are drawn with the location of the various stations indicated along the top of the Figure; this illustrates the general thermal structure seen during this cruise. Figure 2(c) enlarges the upper 200 m of Figure 2(b) so that the features of the thermal field above and just below the permanent thermocline can be more readily visualized.

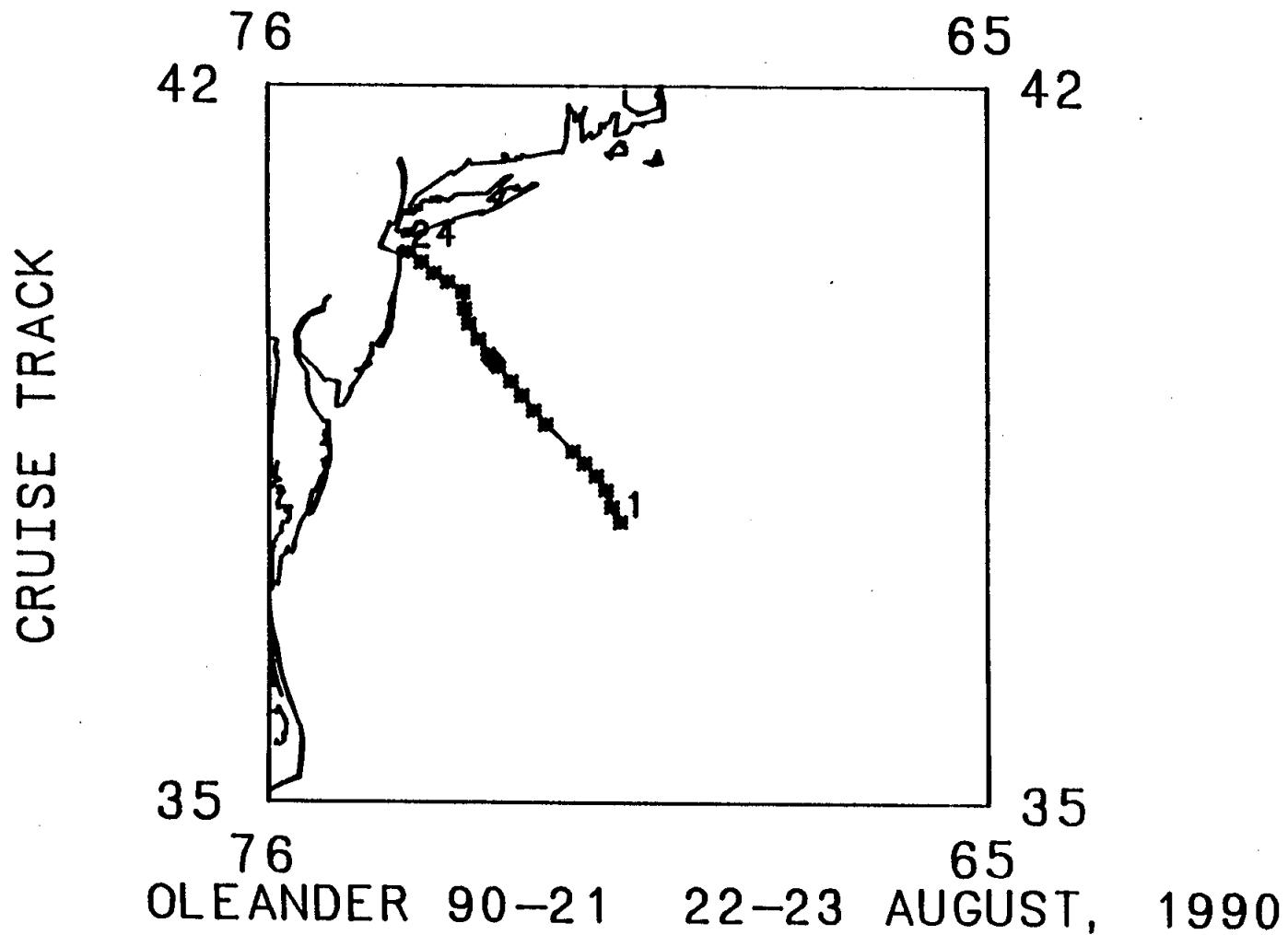


Figure 1. A regional map with the cruise track of the M/V *Oleander* shown. The station locations are indicated by a square and the end points are numbered so that other stations number can be determined.

Table 1. M/V *Oleander* cruise numbers and the dates on which stations were occupied.

M/V Oleander Cruise ID	Cruise Date
90-03-----	March 2-3, 1990
90-04-----	April 6, 1990
90-05-----	April 20, 1990
90-06-----	April 25-26, 1990
90-07-----	May 4, 1990
90-08-----	May 9-10, 1990
90-09-----	May 30-31, 1990
90-10-----	June 8, 1990
90-11-----	June 13-14, 1990
90-12-----	June 22, 1990
90-13-----	June 27-28, 1990
90-14-----	July 6, 1990
90-15-----	July 11-12, 1990
90-16-----	July 20, 1990
90-17-----	July 25-26, 1990
90-18-----	No Data; Instr. Malfunction
90-19-----	August 8-9, 1990
90-20-----	August 17, 1990
90-21-----	August 22-23, 1990

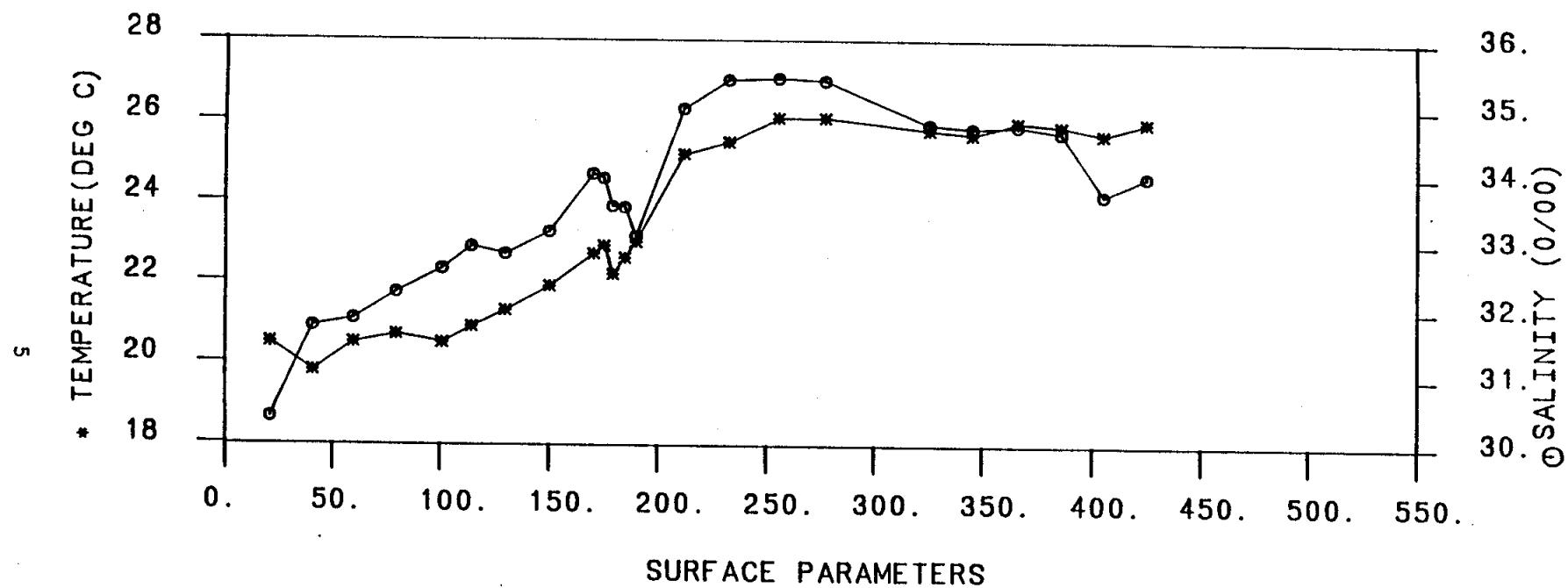


Figure 2(a). A plot of surface temperature and salinity as a function of along-track distance. The origin is located at the inshore end of the transect.

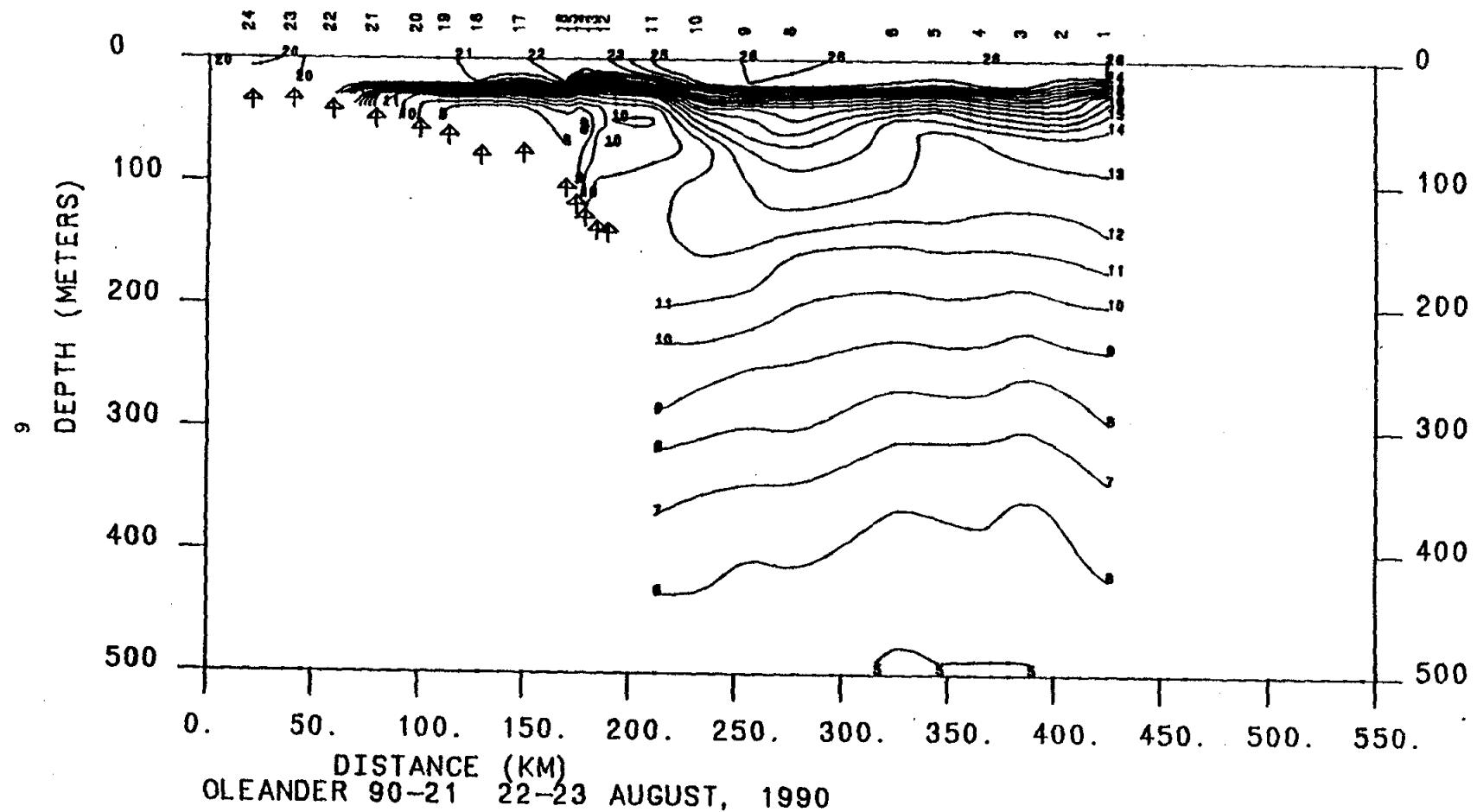


Figure 2(b). Contour plot of temperature as a function of depth and along-track distance. The XBTs measured temperature to a depth of 460 m (nominal). Isotherms are shown for integer values of temperature.

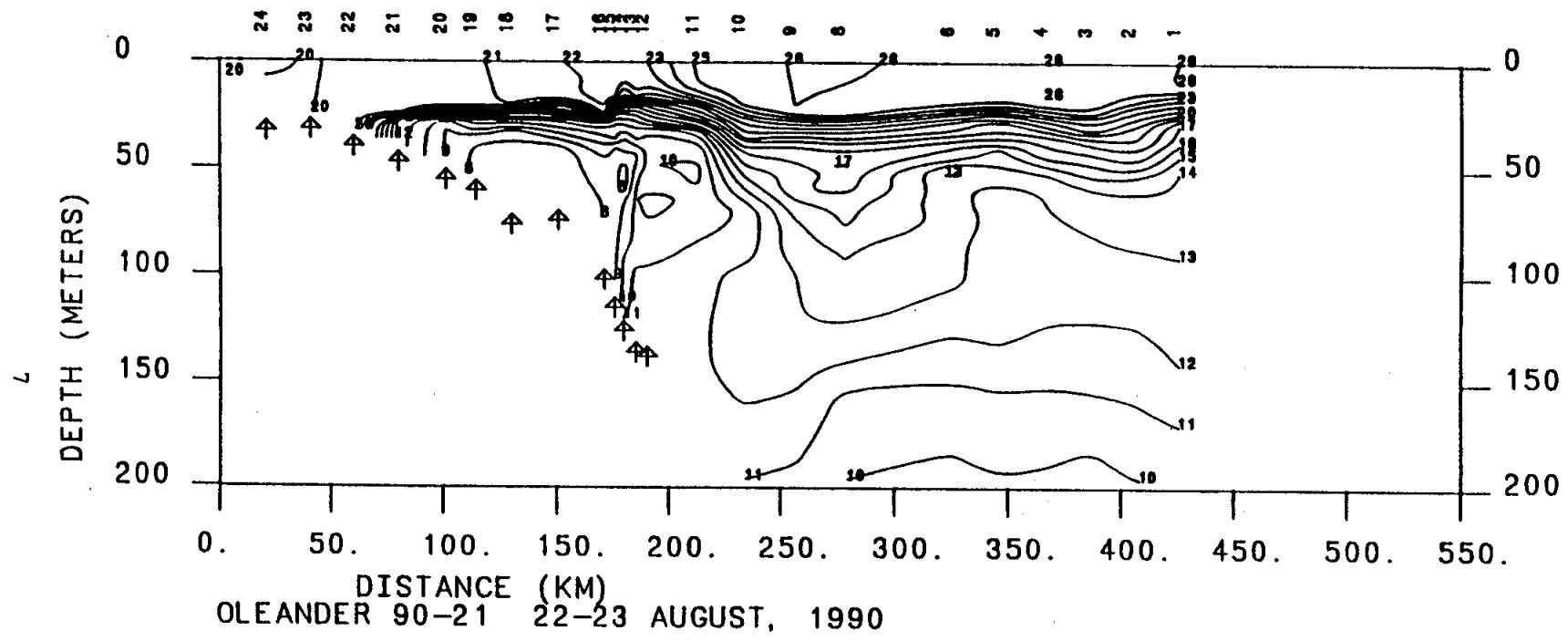


Figure 2(c). Enlargement of isotherm contours in the upper 200 m of the water column.

Data products for each cruise are presented in Figures 3 through 21. They have not been edited and are either enlargements or reductions of those received from NOAA.

5.0 REFERENCES

- Battelle. 1990a. Draft of the 106-Mile Deepwater Municipal Sludge Site Monitoring, Research, and Surveillance Plan. A report submitted to the U.S. Environmental Protection Agency under Contract No. 68-C8-0105. Work Assignment 1-14.
- Battelle. 1990b. Draft Quality Assurance Project Plan for the 106-Mile Site Sediment Trap Program: Equipment Preparation and Mooring Deployment and Recovery. A report submitted to the U.S. Environmental Protection Agency under Contract 68-C8-0105. Work Assignment 1-110.
- Battelle. 1988. Final Draft Monitoring Plan for the 106-Mile Deepwater Municipal Sludge Site. A report submitted to the U. S. Environmental Protection Agency under Contract No. 68-03-3319. Work Assignment 1-22.

Figure 3. M/V *Oleander* Cruise 90-03, March 2-3, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

or

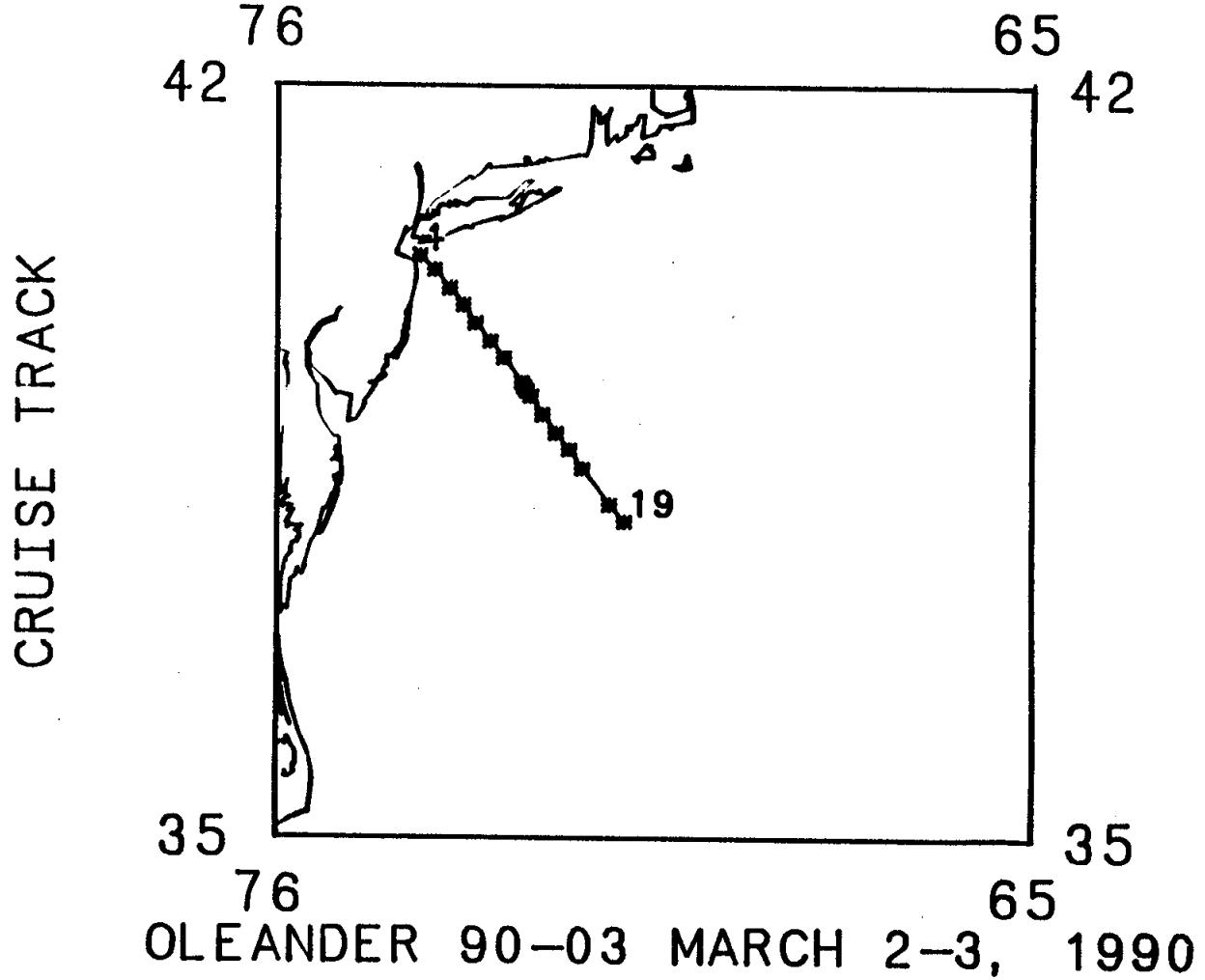


Figure 3(a). Cruise track and locations of XBT stations.

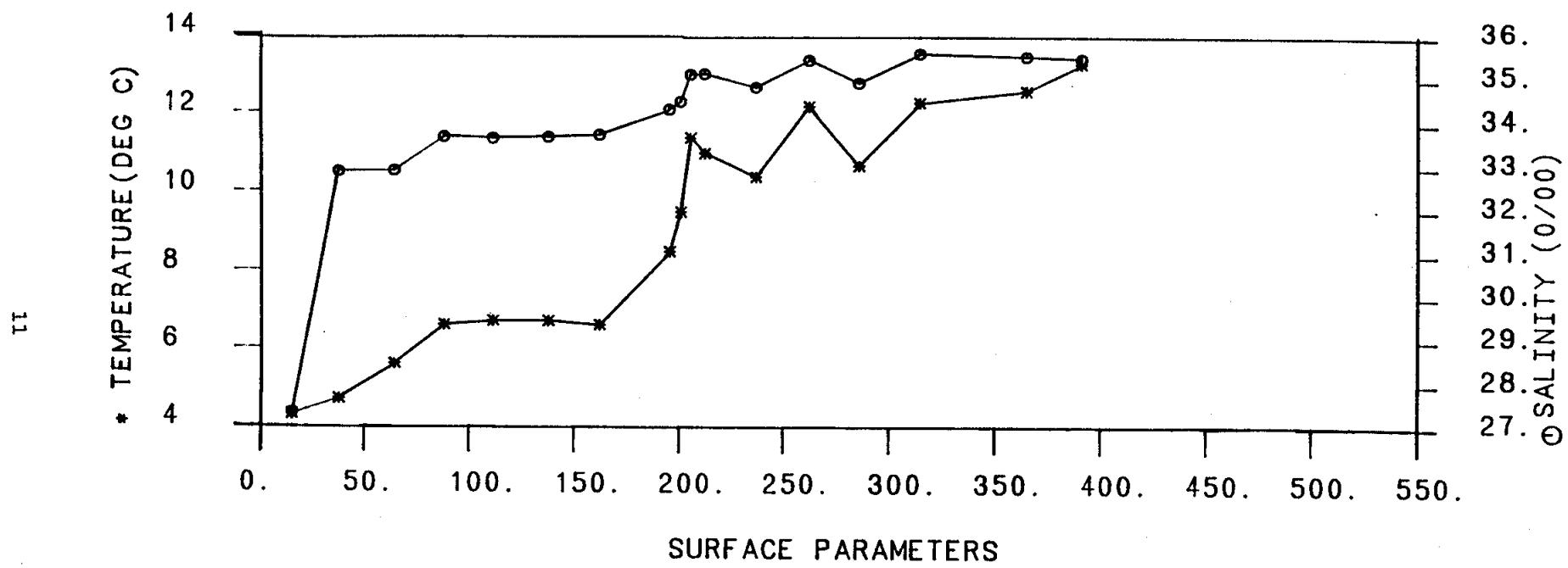


Figure 3(b). Surface temperature and salinity.

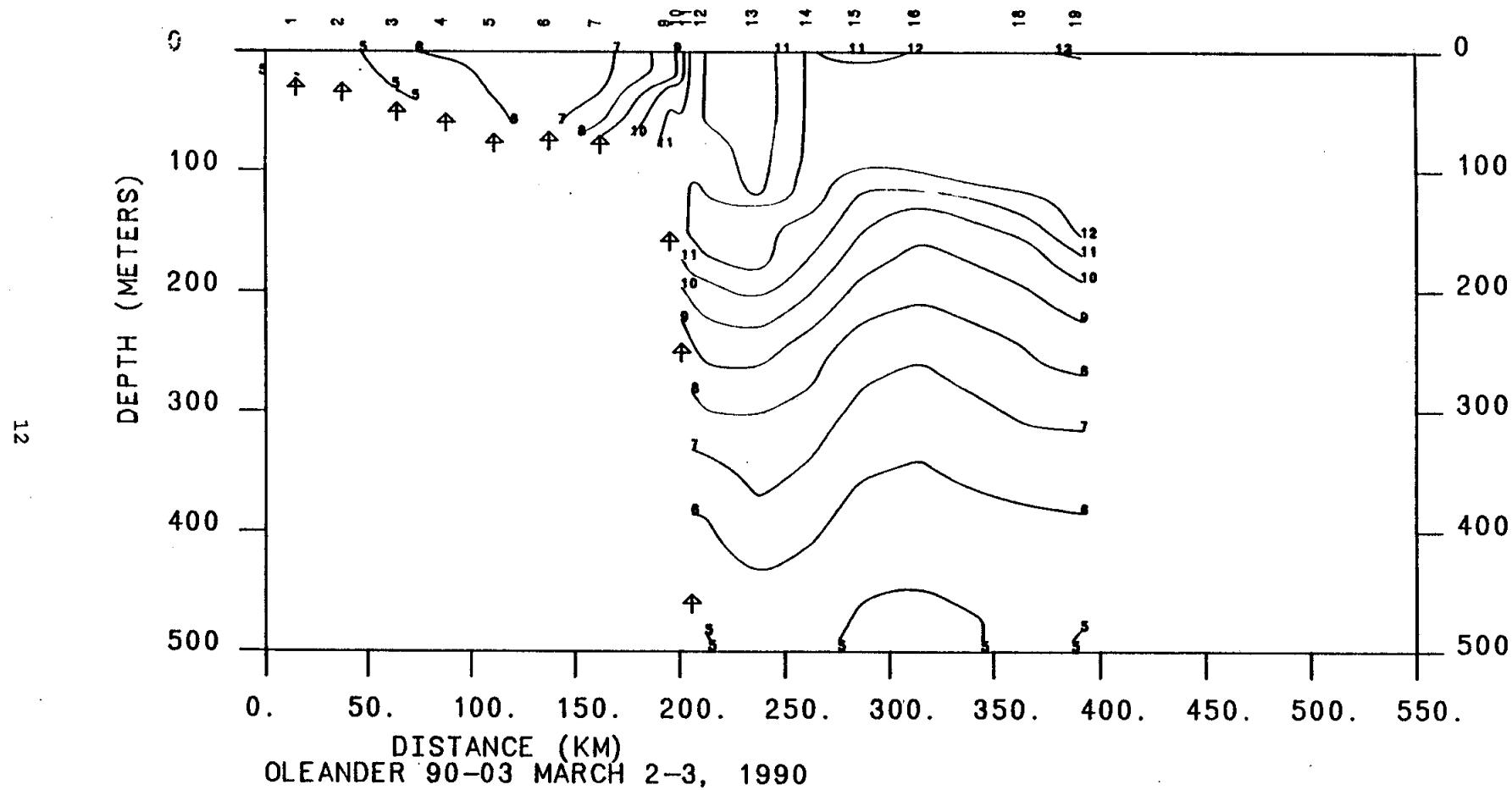


Figure 3(c). Contour plot of integer-valued isotherms to 500 m.

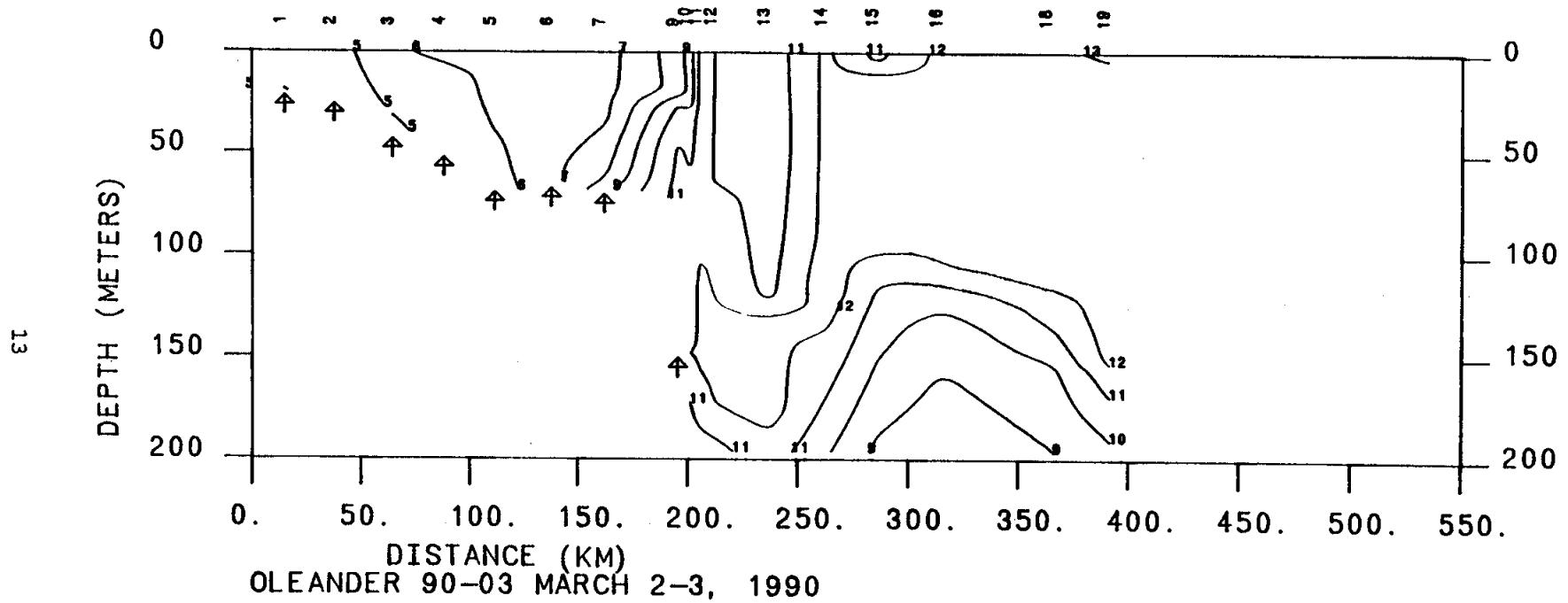


Figure 3(d). Contour plot of integer-valued isotherms to 200 m.

Figure 4. M/V *Oleander* Cruise 90-04, April 6, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

ST

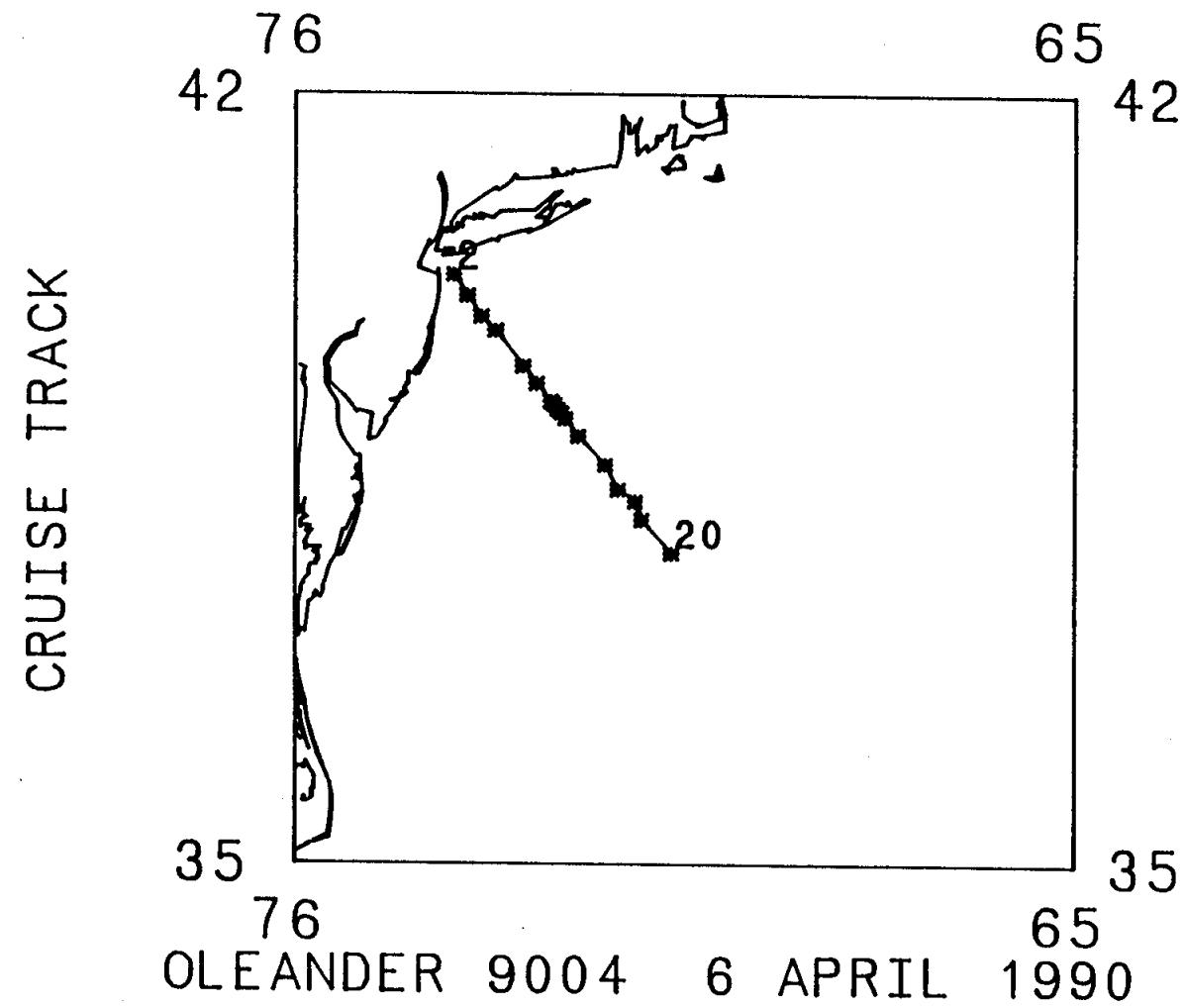


Figure 4(a). Cruise track and locations of XBT stations.

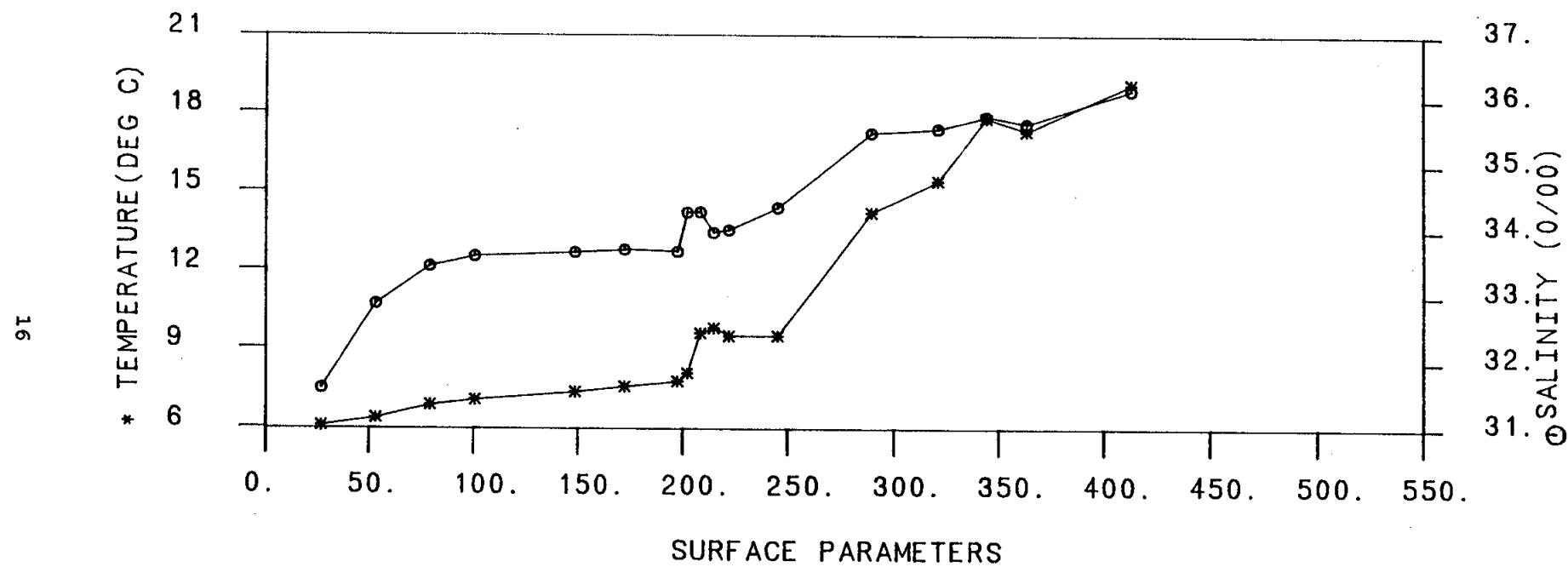


Figure 4(b). Surface temperature and salinity.

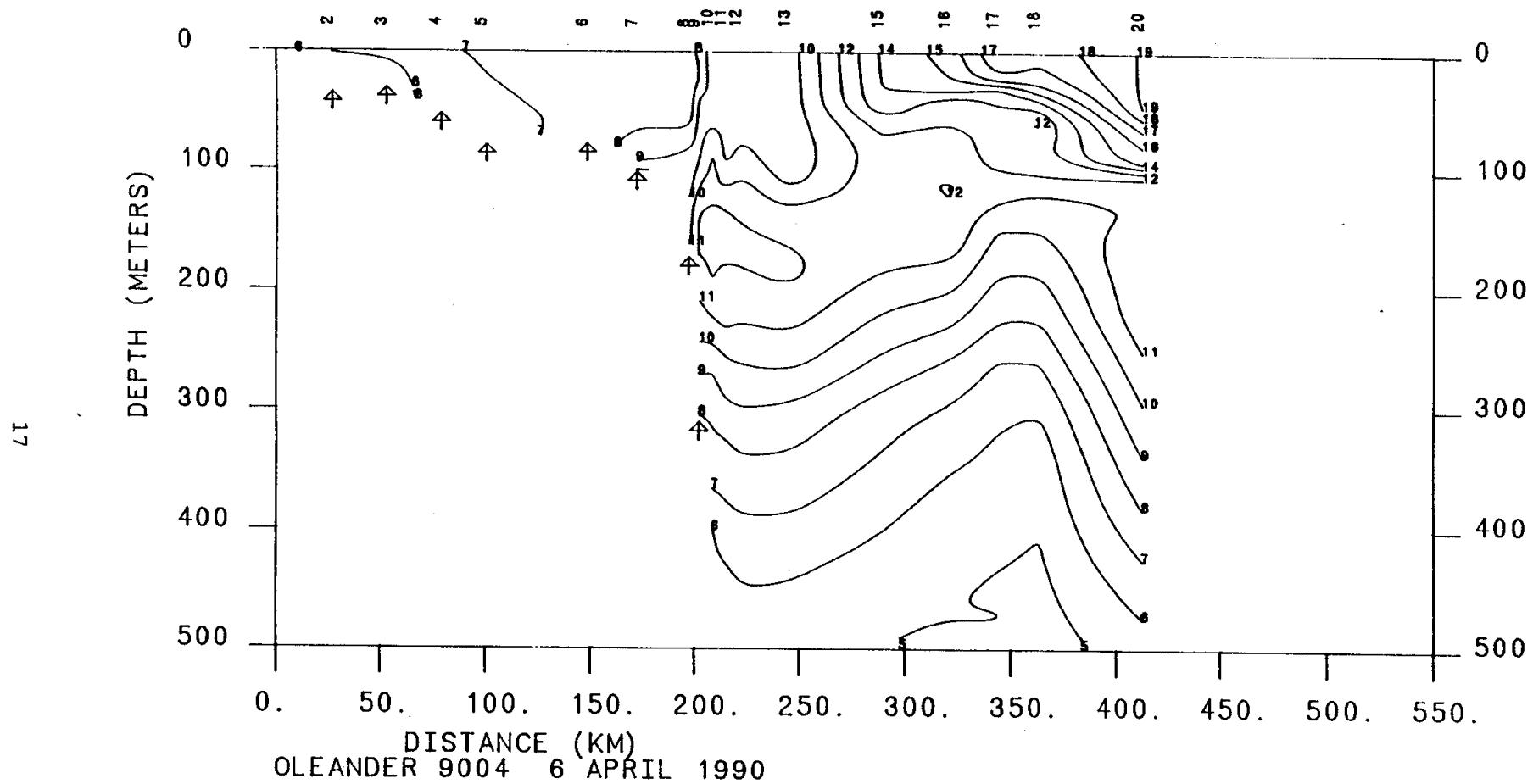


Figure 4(c). Contour plot of integer-valued isotherms to 500 m.

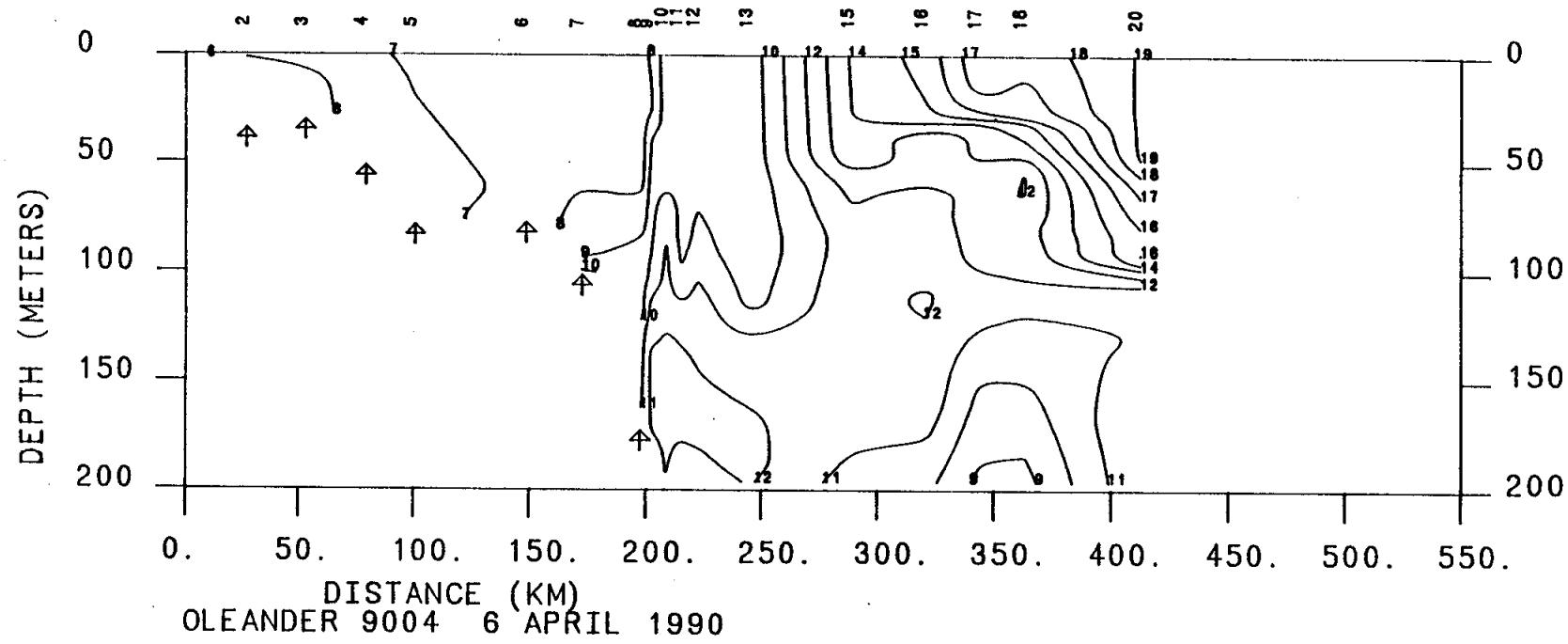


Figure 4(d). Contour plot of integer-valued isotherms to 200 m.

Figure 5. M/V *Oleander* Cruise 90-05, April 20, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m. of isotherms along the cruise track.
- d. Contour plot to 200 m. of isotherms along the cruise track.

20

CRUISE TRACK

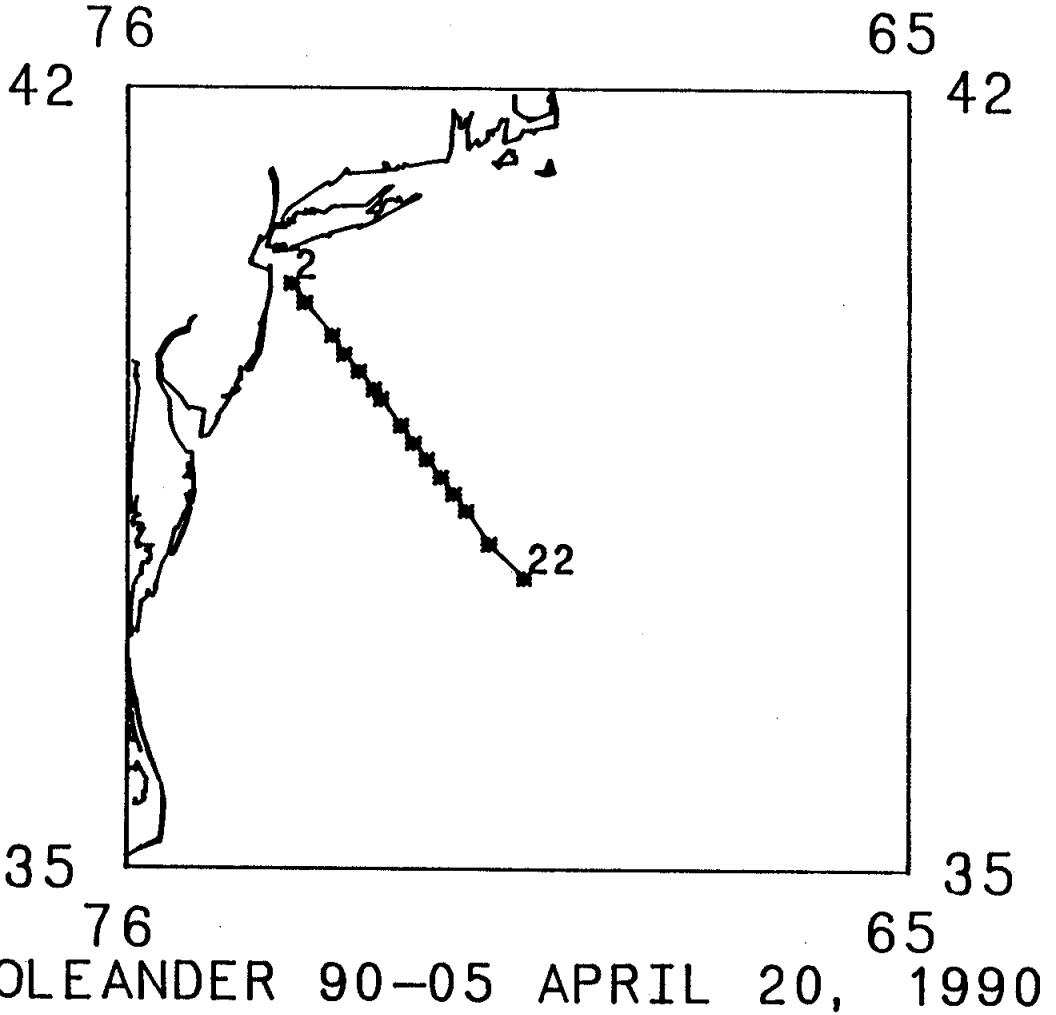


Figure 5(a). Cruise track and locations of XBT stations.

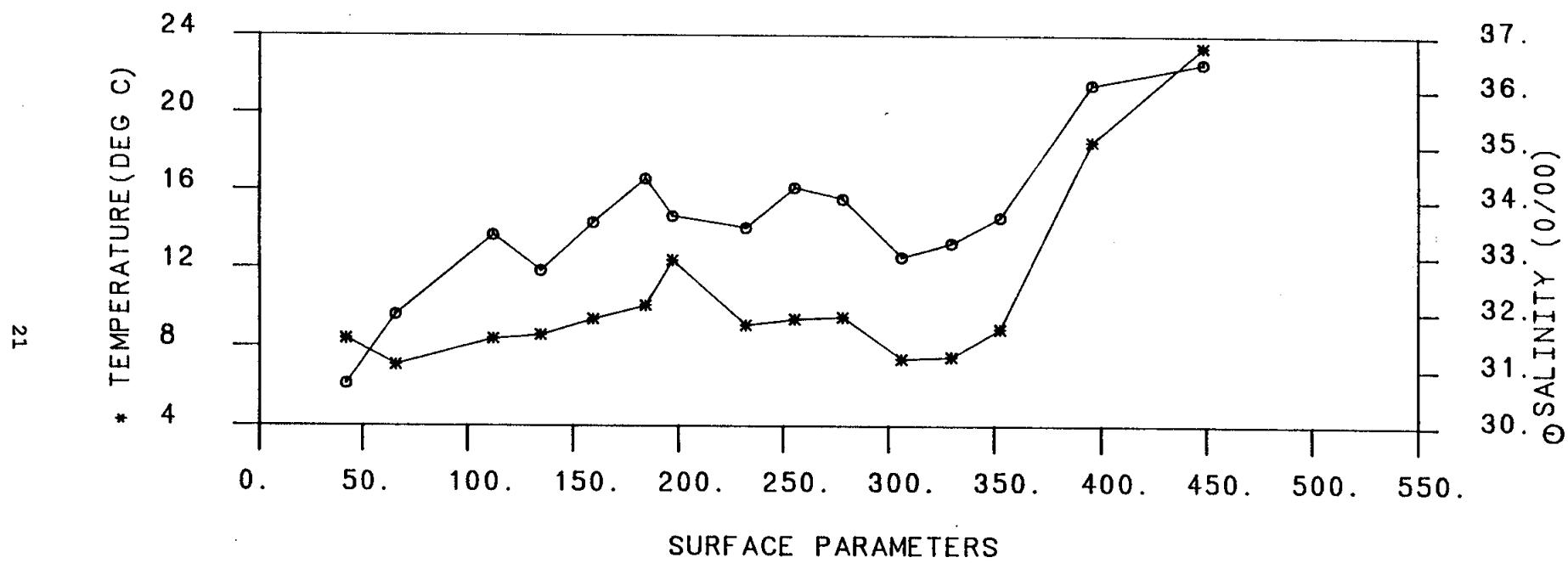


Figure 5(b). Surface temperature and salinity.

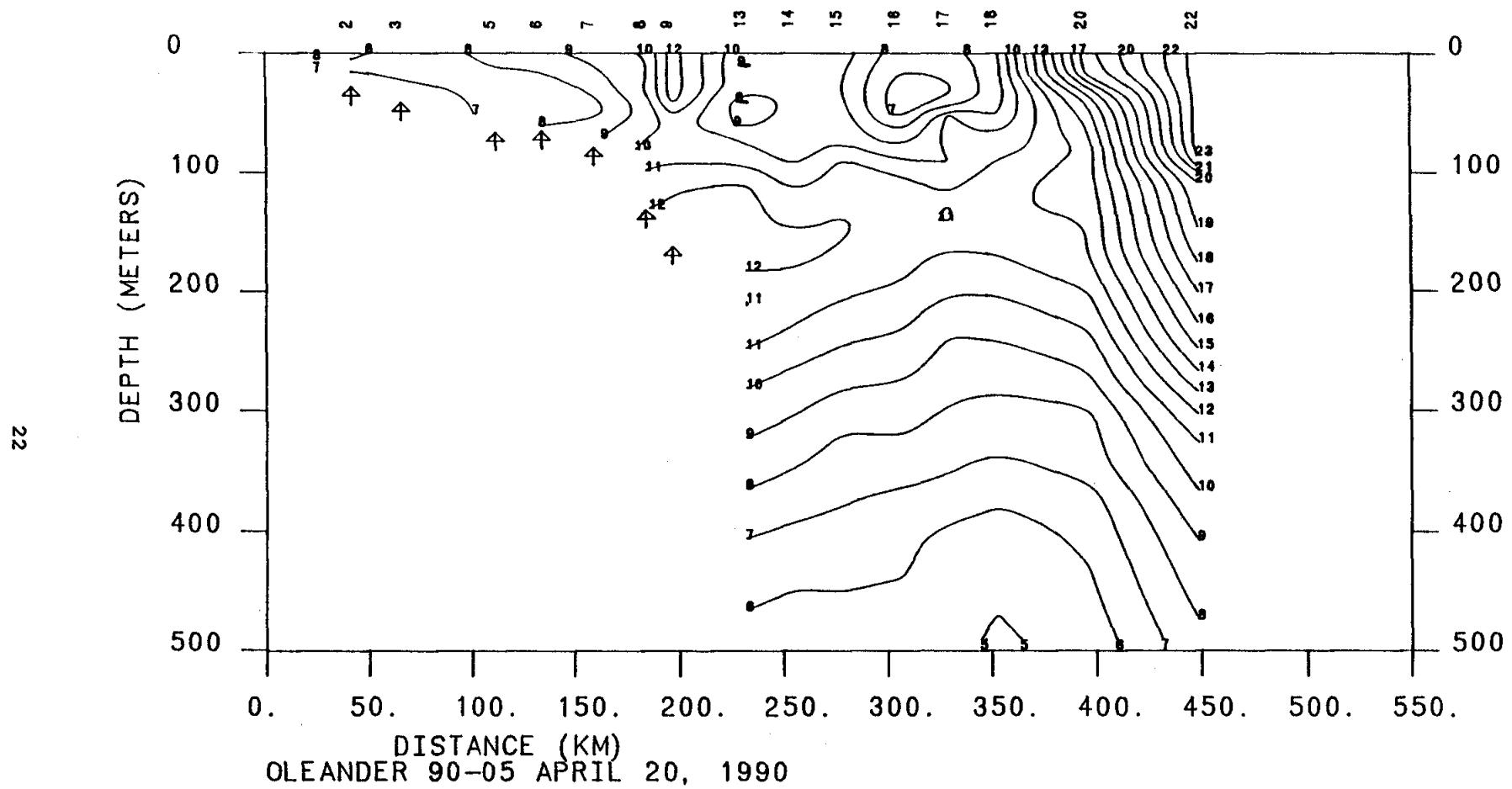


Figure 5(c). Contour plot of integer-valued isotherms to 500 m.

23

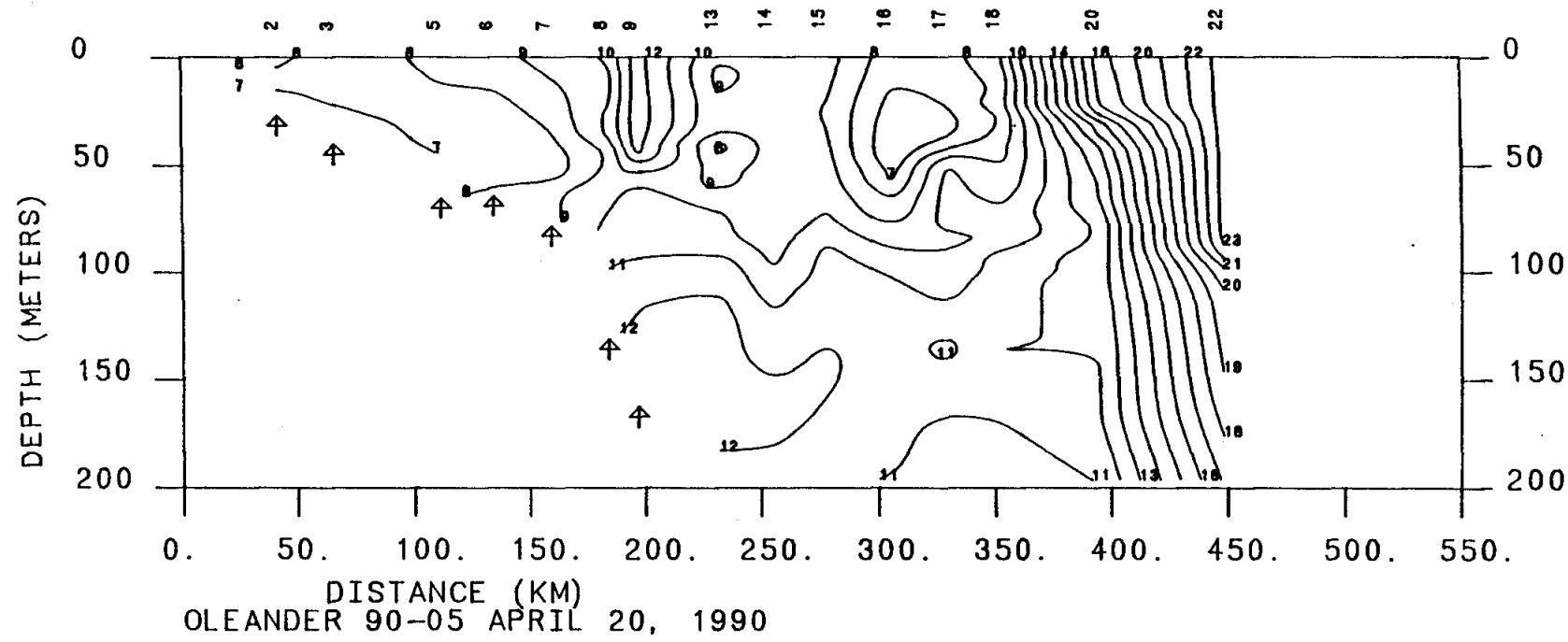


Figure 5(d). Contour plot of integer-valued isotherms to 200 m.

Figure 6. M/V *Oleander* Cruise 90-06, April 25-26, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

25

Cruise track

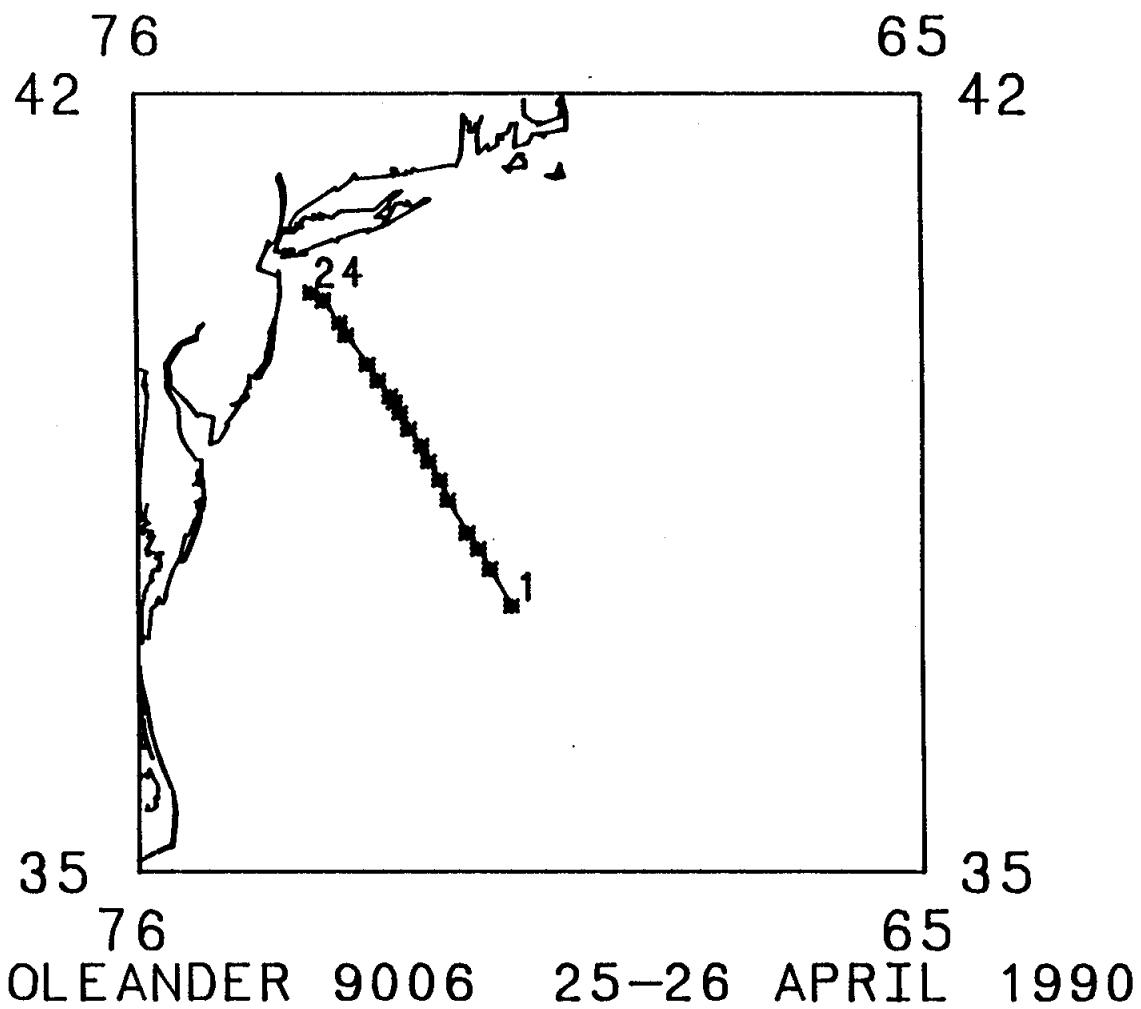


Figure 6(a). Cruise track and locations of XBT stations.

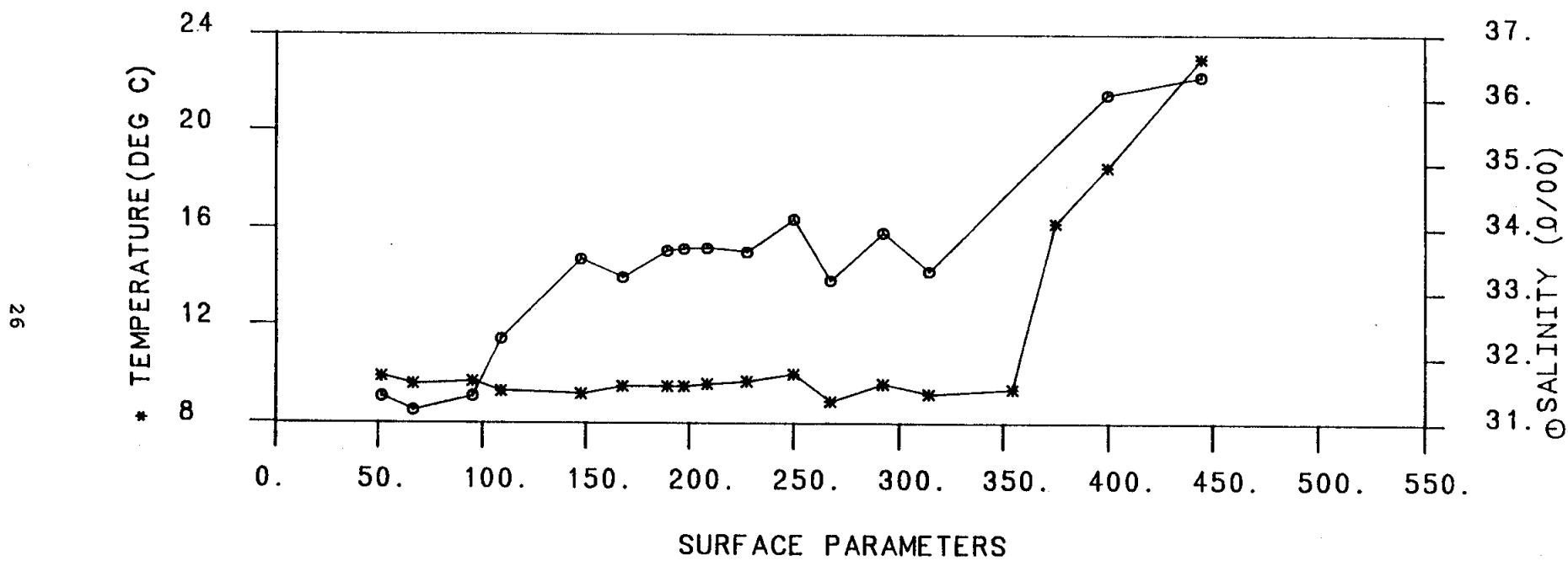


Figure 6(b). Surface temperature and salinity.

27

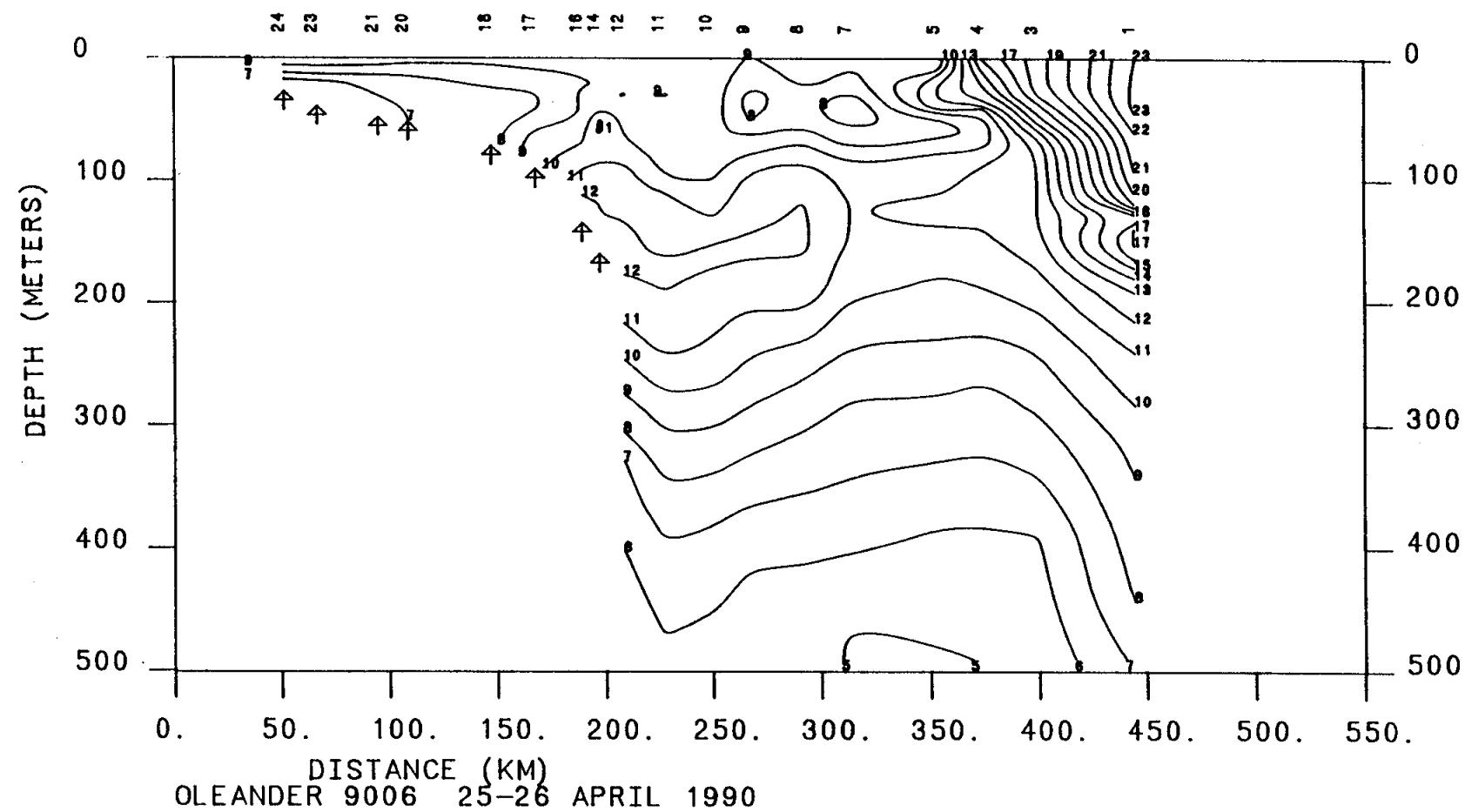


Figure 6(c). Contour plot of integer-valued isotherms to 500 m.

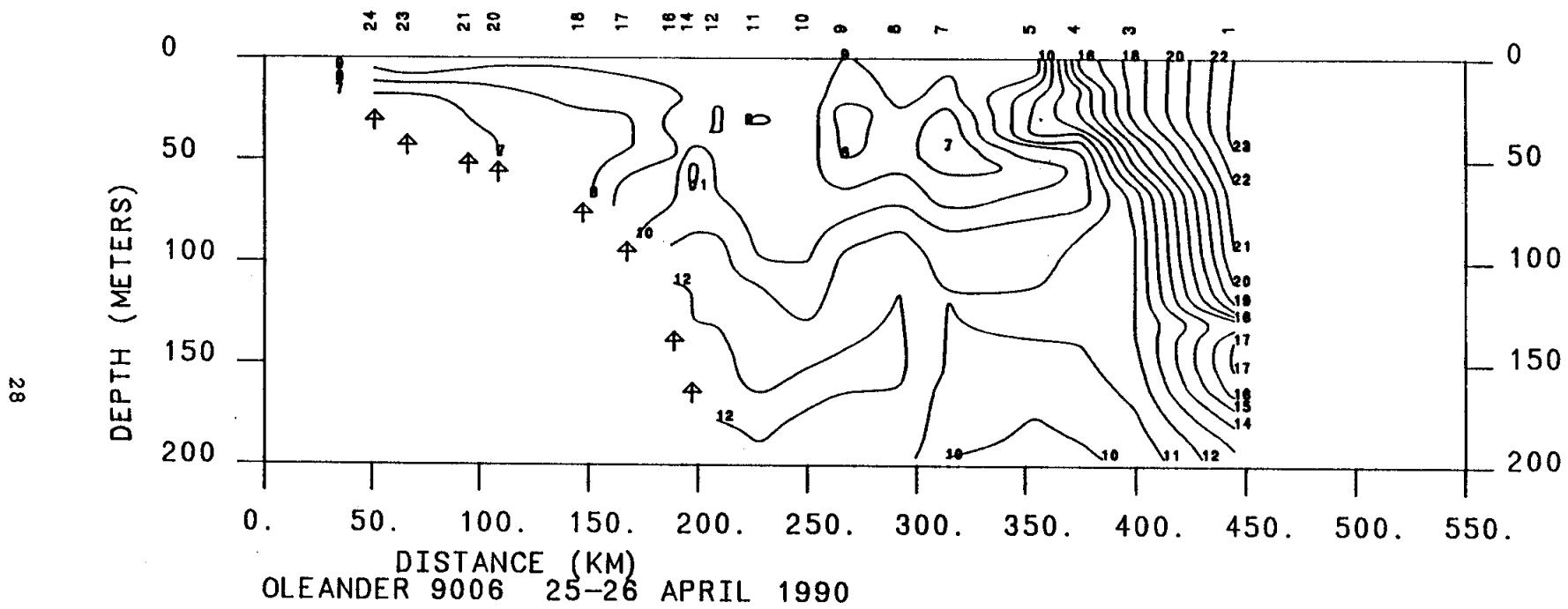


Figure 6(d). Contour plot of integer-valued isotherms to 200 m.

Figure 7. M/V *Oleander* Cruise 90-07, May 4, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

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CRUISE TRACK

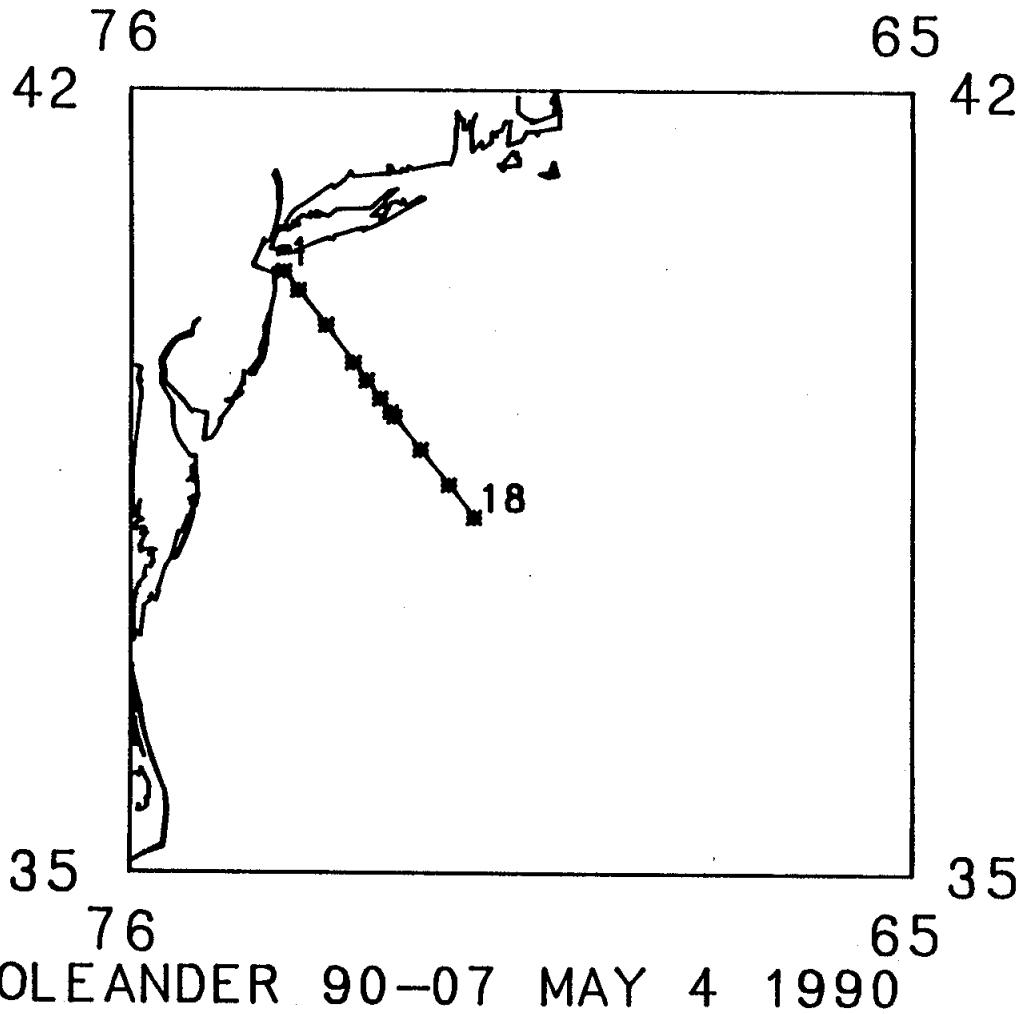


Figure 7(a). Cruise track and locations of XBT stations.

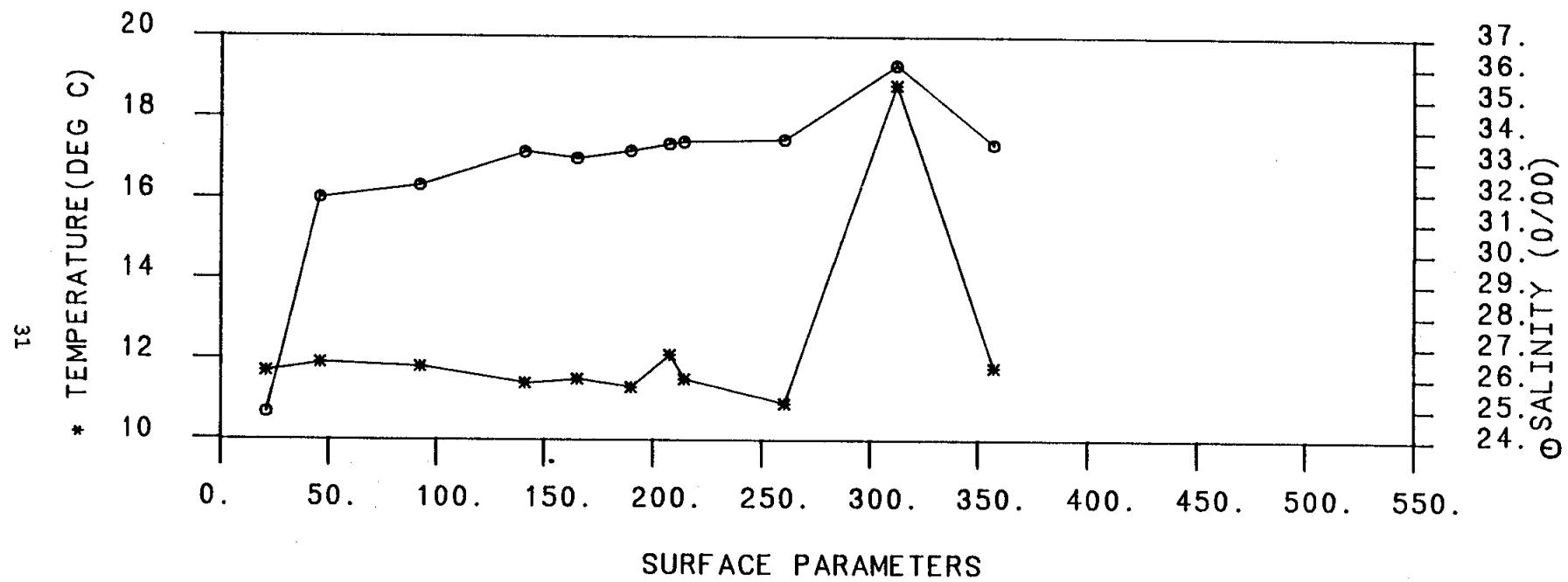


Figure 7(b). Surface temperature and salinity.

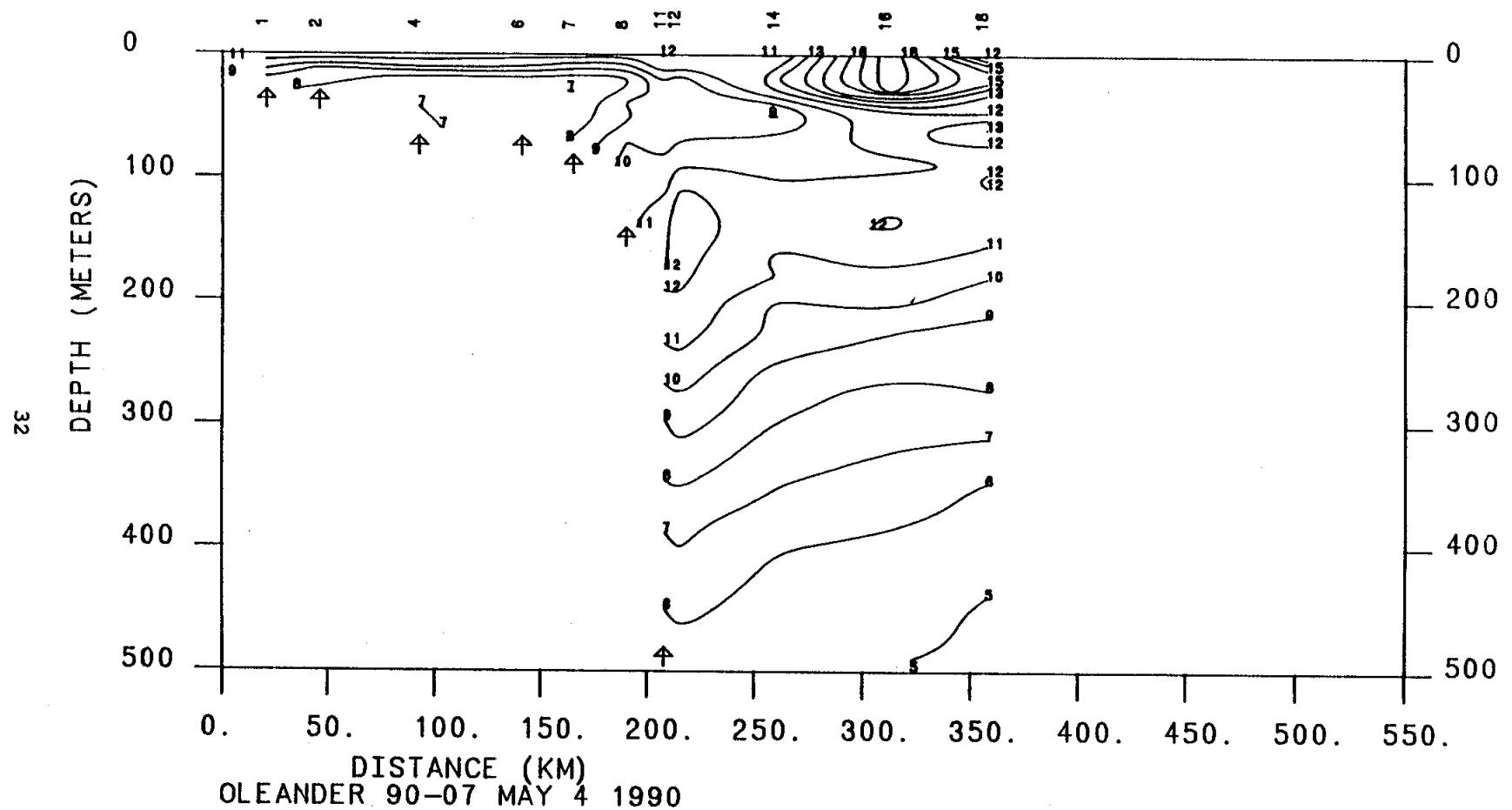


Figure 7(c). Contour plot of integer-valued isotherms to 500 m.

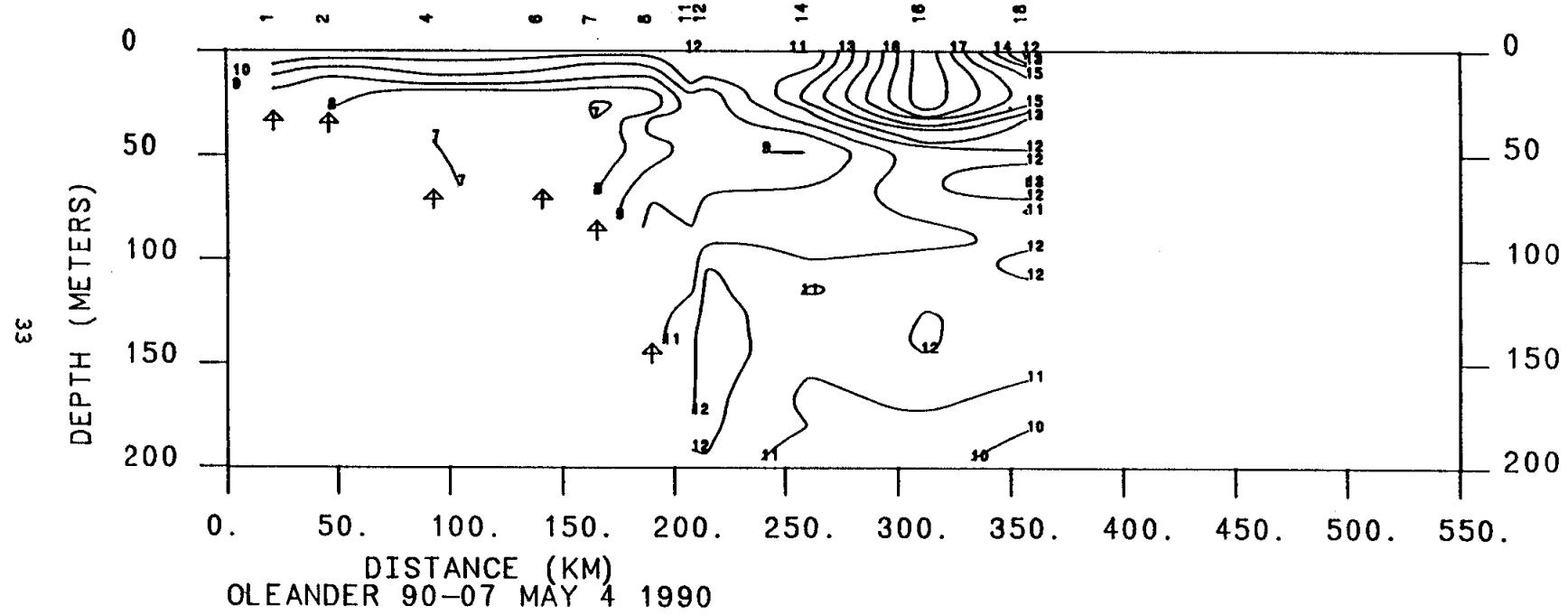


Figure 7(d). Contour plot of integer-valued isotherms to 200 m.

Figure 8. M/V *Oleander* Cruise 90-08, May 9-10, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m. of isotherms along the cruise track.
- d. Contour plot to 200 m. of isotherms along the cruise track.

SE

CRUISE TRACK

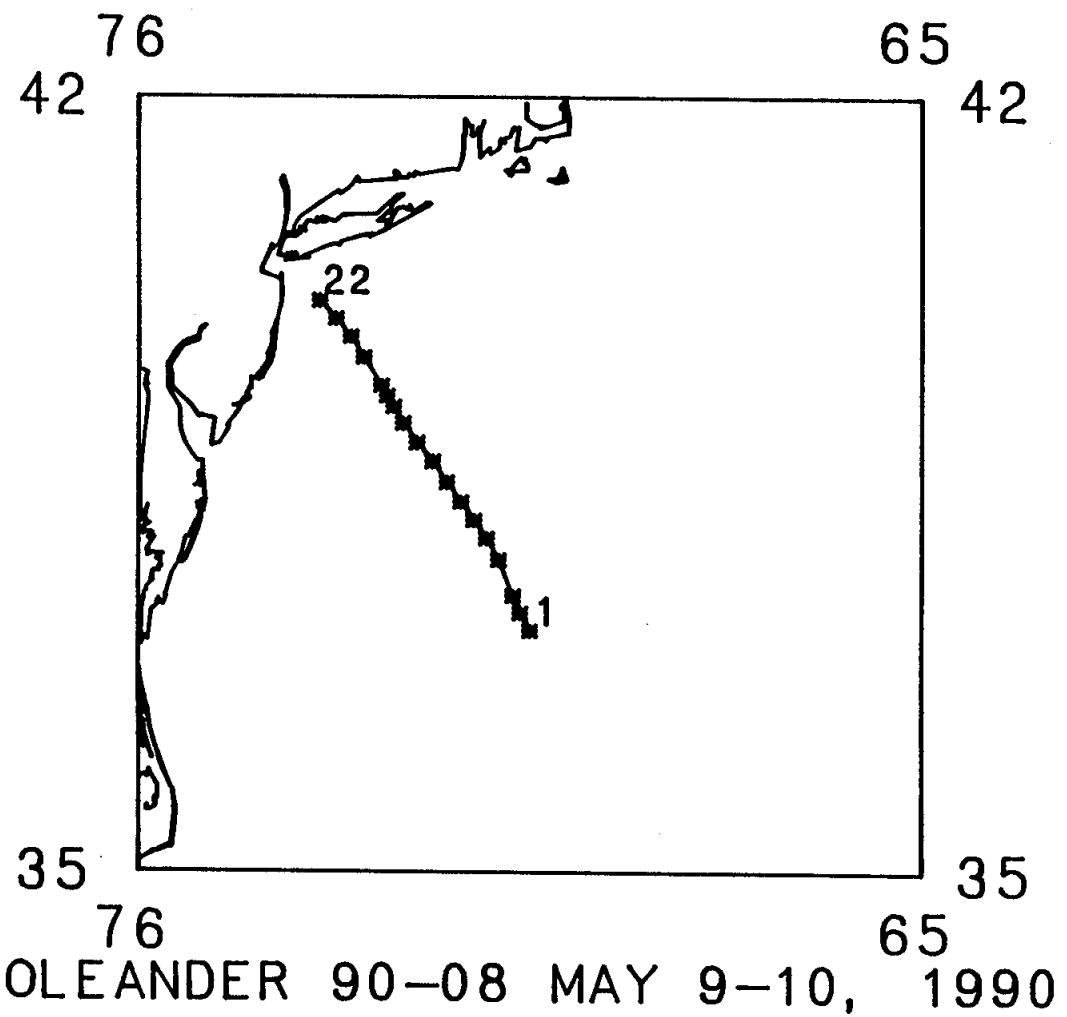


Figure 8(a). Cruise track and locations of XBT stations.

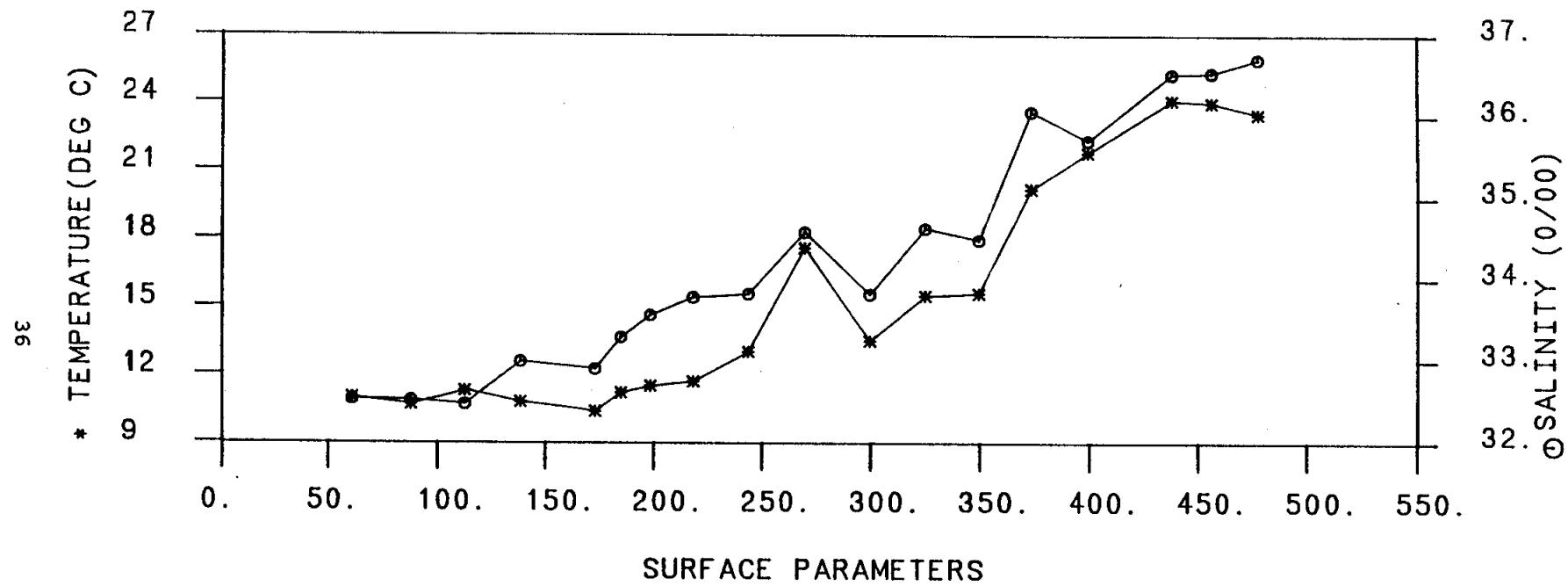


Figure 8(b). Surface temperature and salinity.

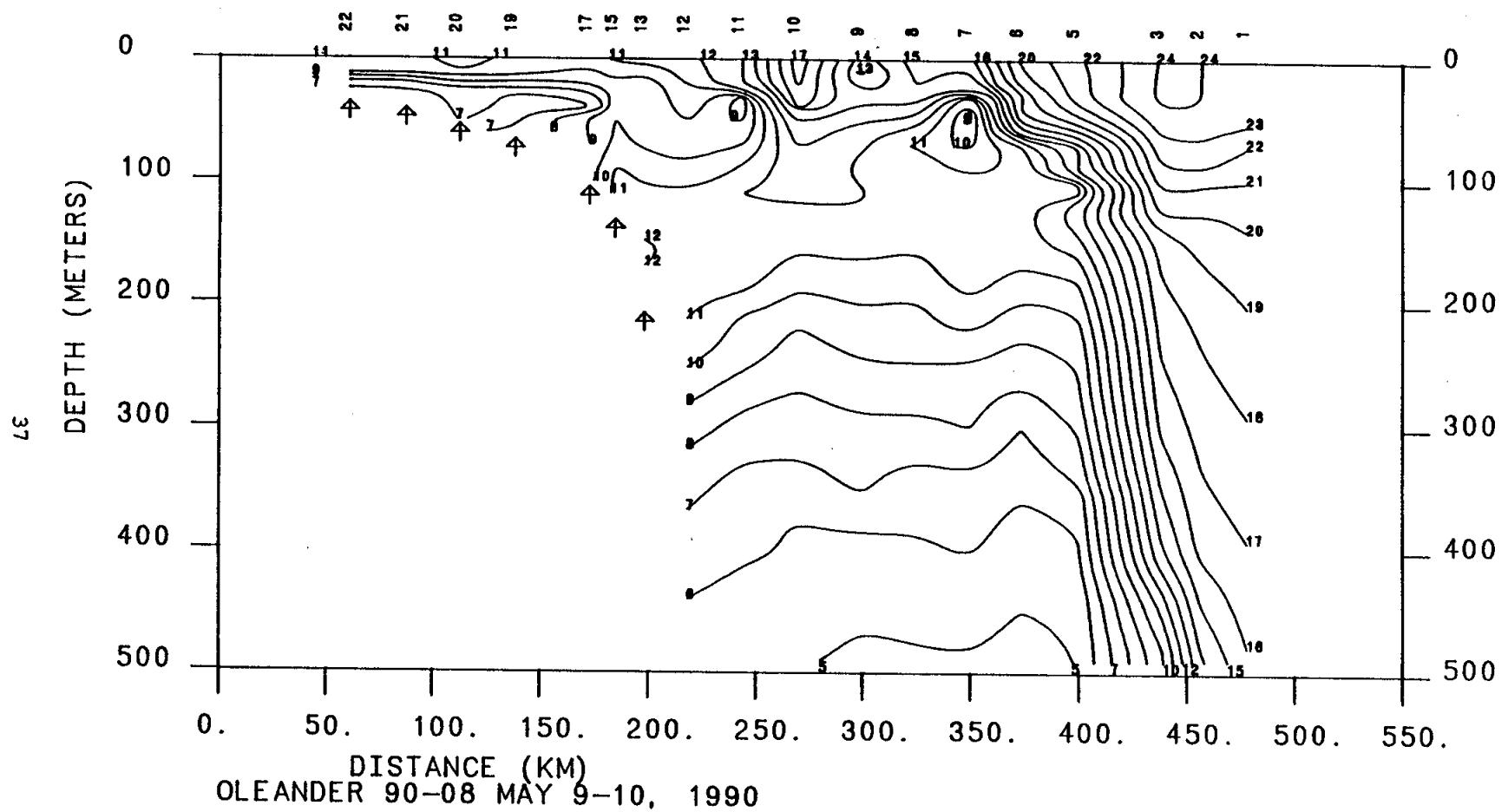
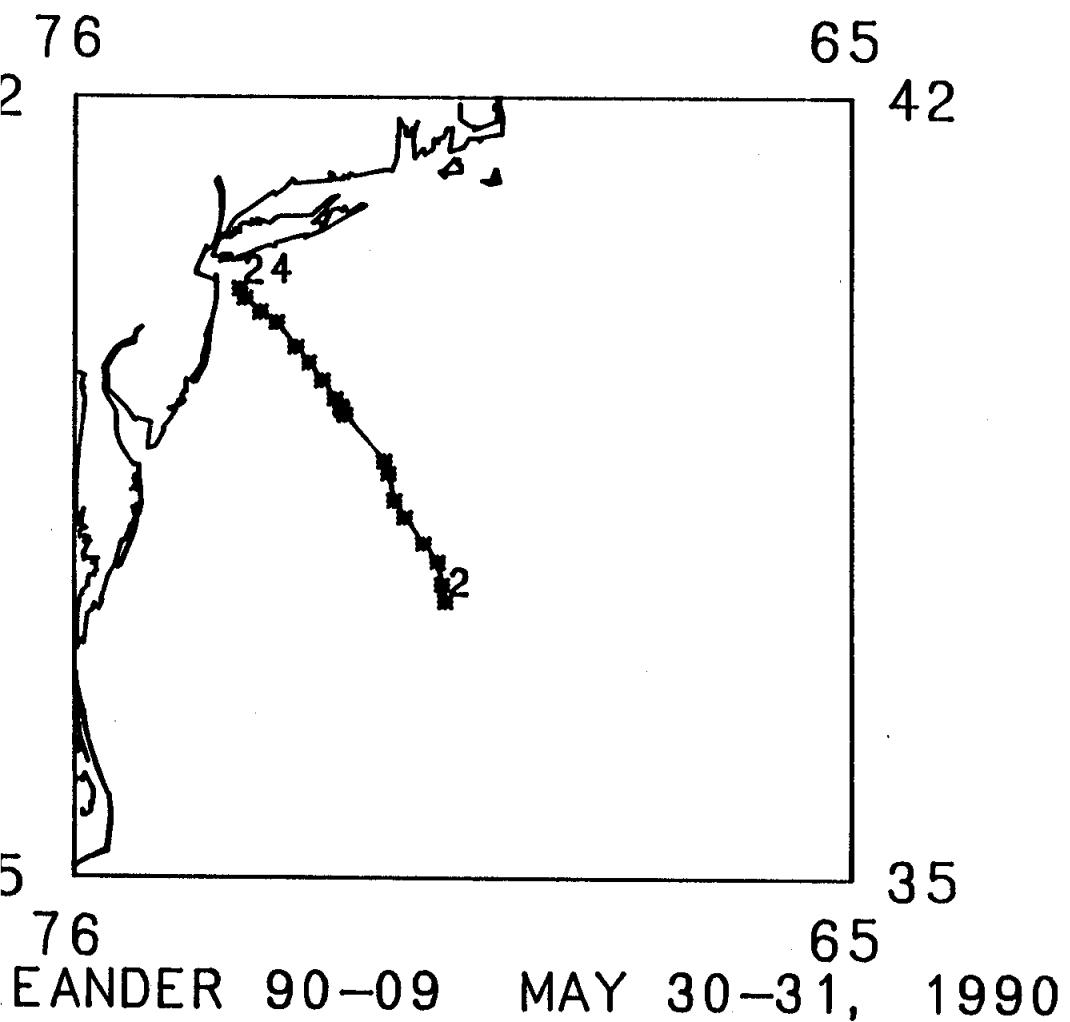


Figure 8(c). Contour plot of integer-valued isotherms to 500 m.



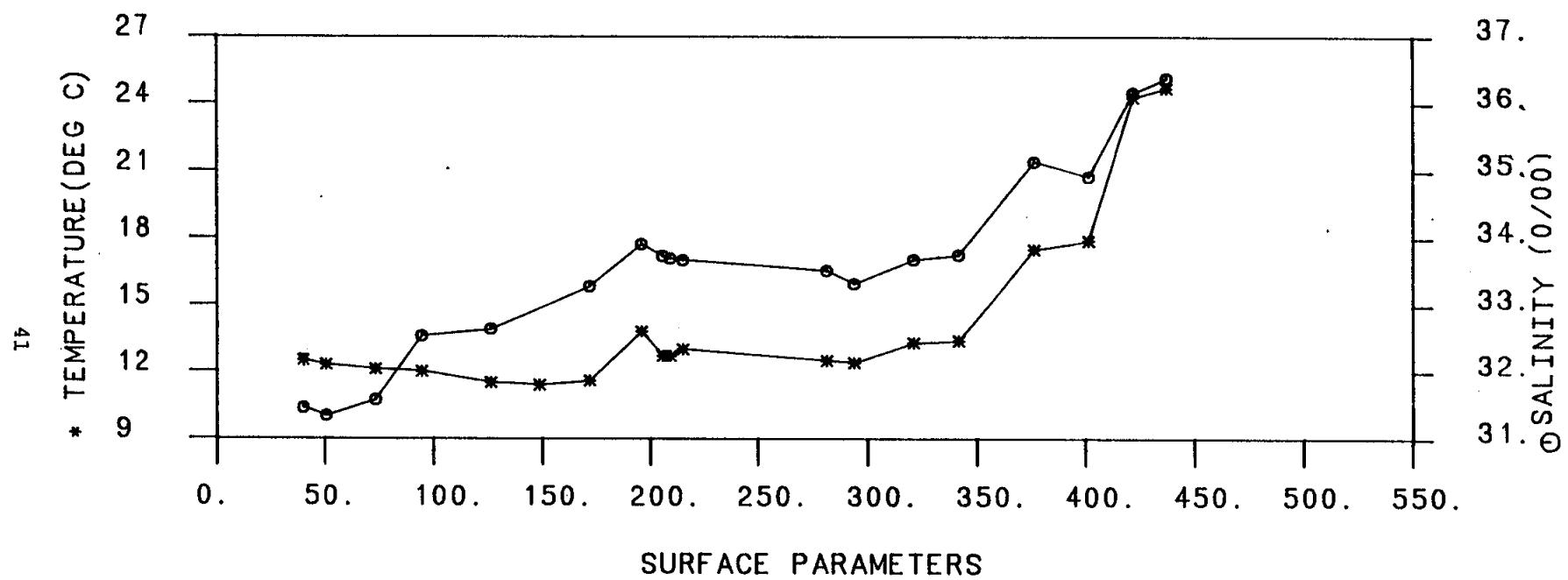


Figure 9(b). Surface temperature and salinity.

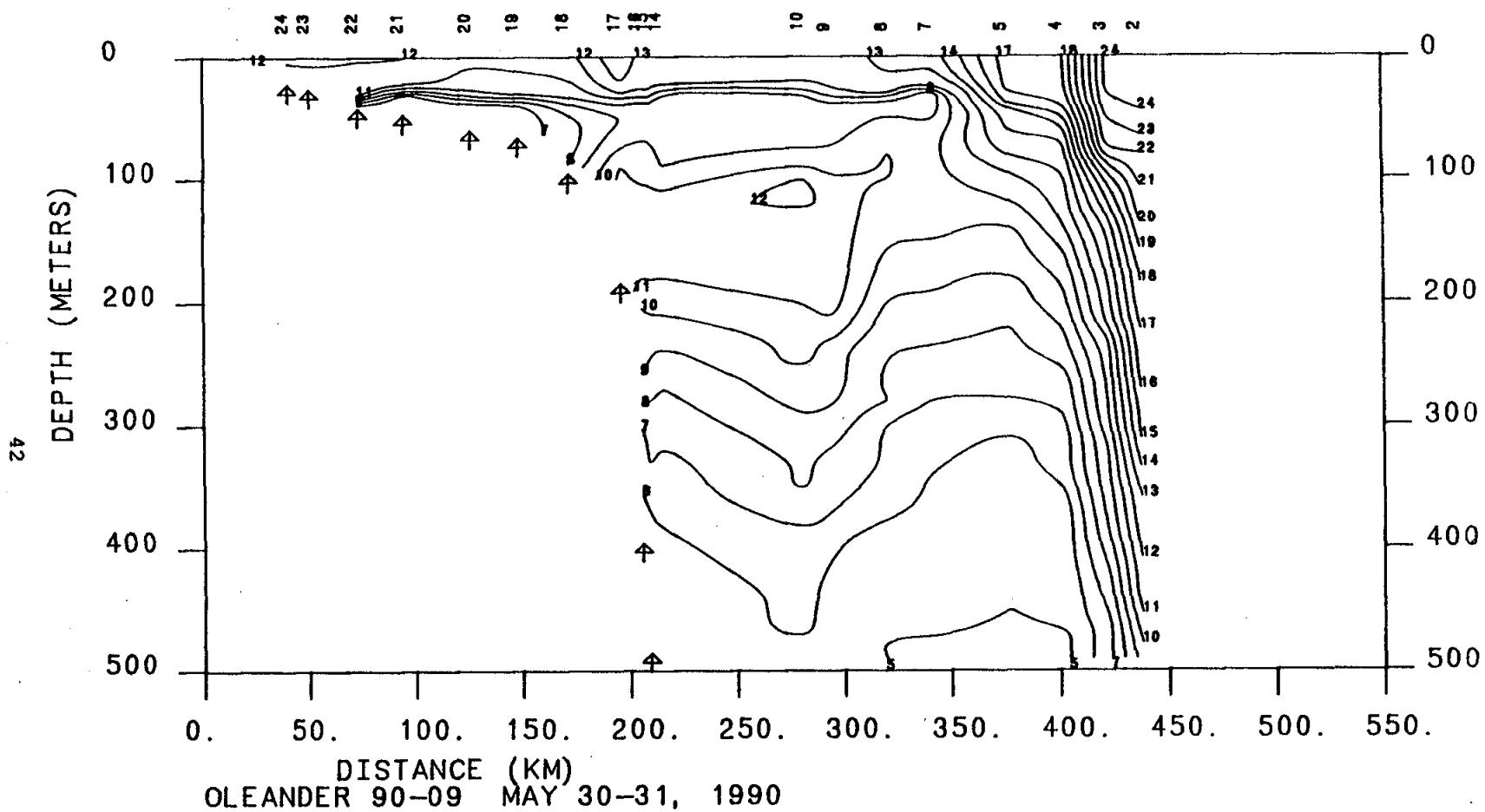


Figure 9(c). Contour plot of integer-valued isotherms to 500 m.

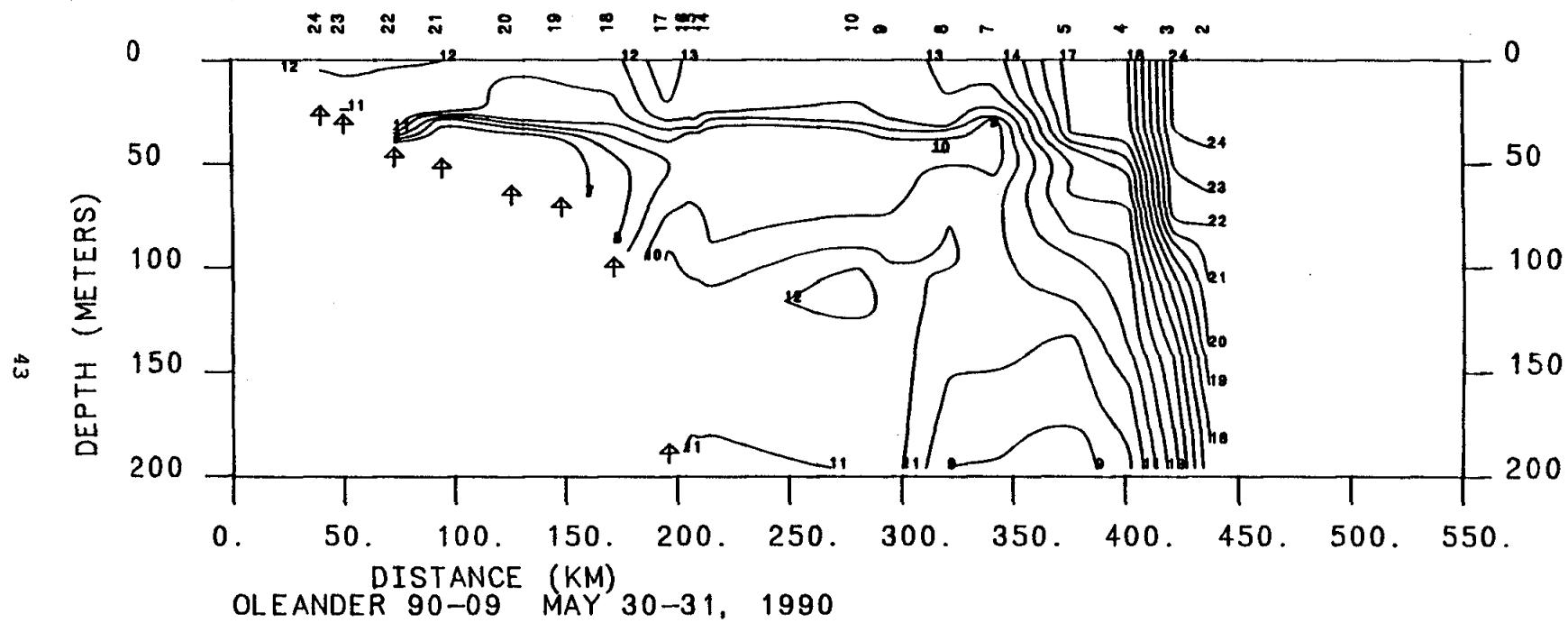


Figure 9(d). Contour plot of integer-valued isotherms to 200 m.

Figure 10. M/V *Oleander* Cruise 90-10, June 8, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

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CRUISE TRACK

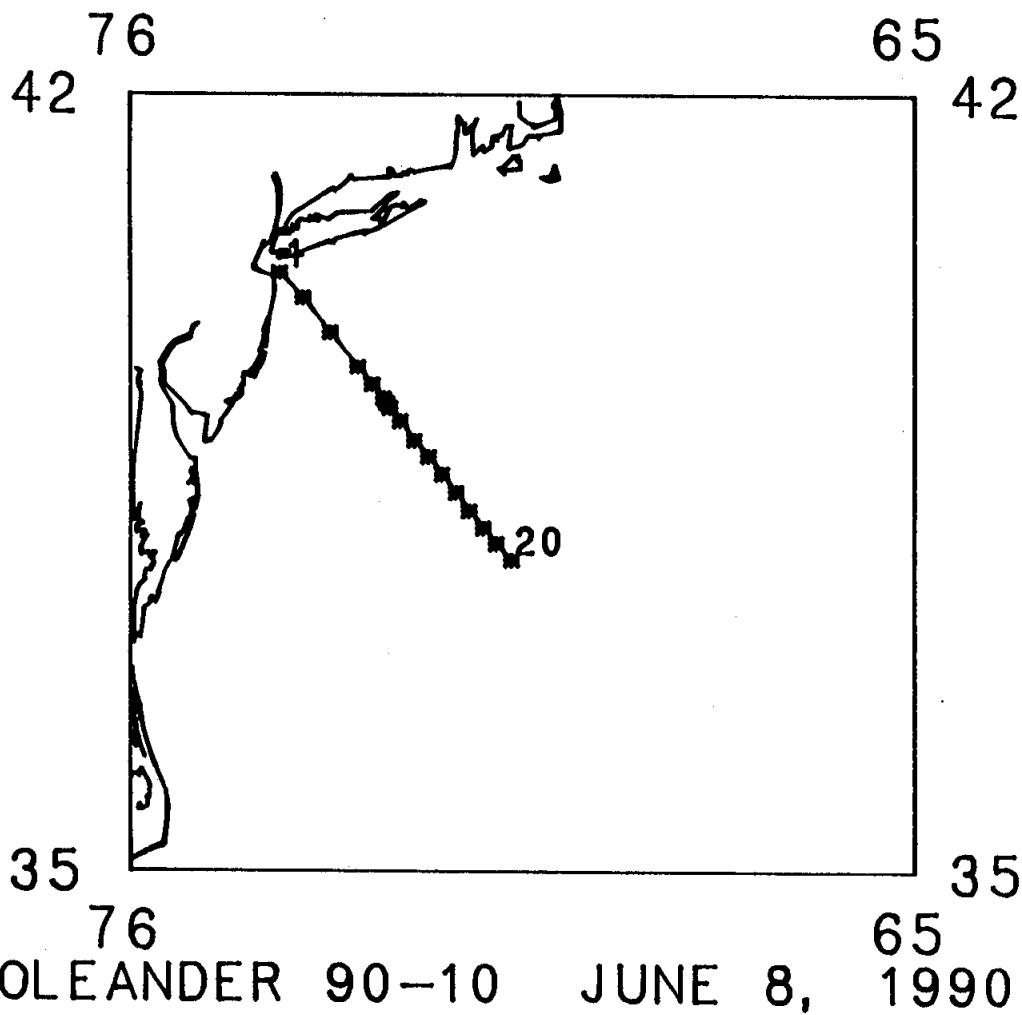


Figure 10(a). Cruise track and locations of XBT stations.

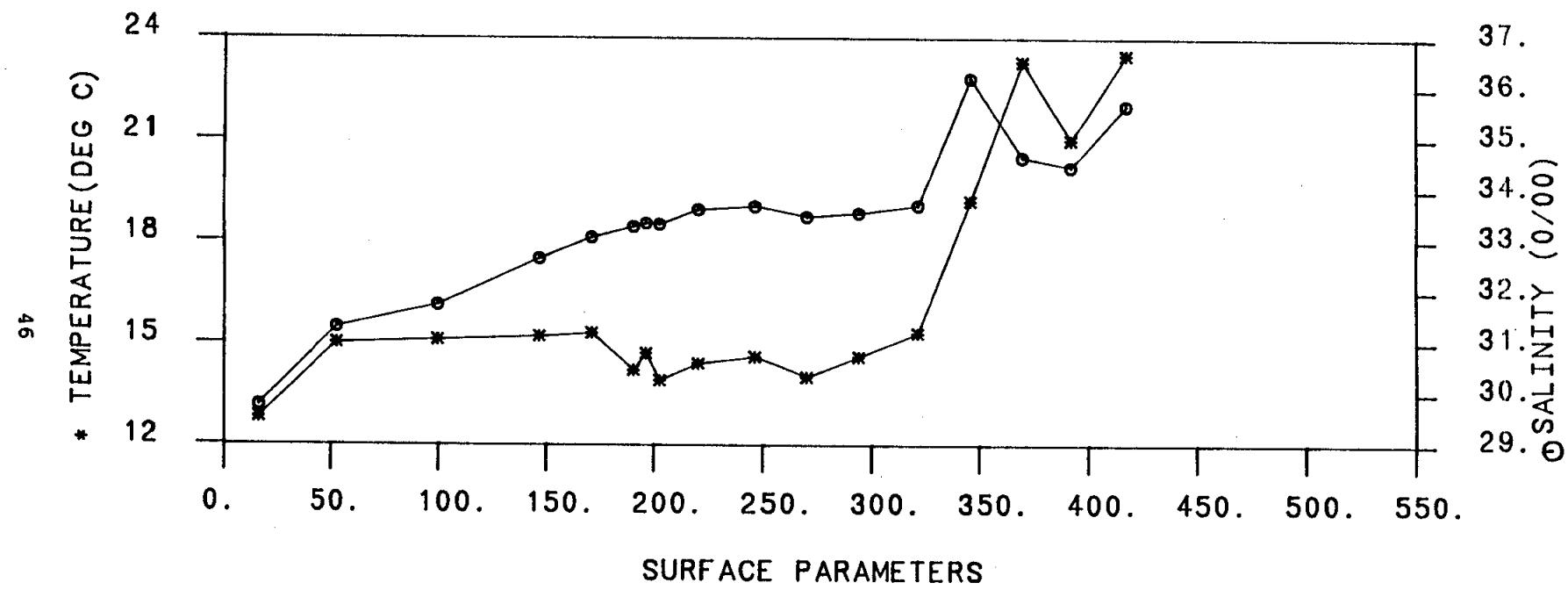


Figure 10(b). Surface temperature and salinity.

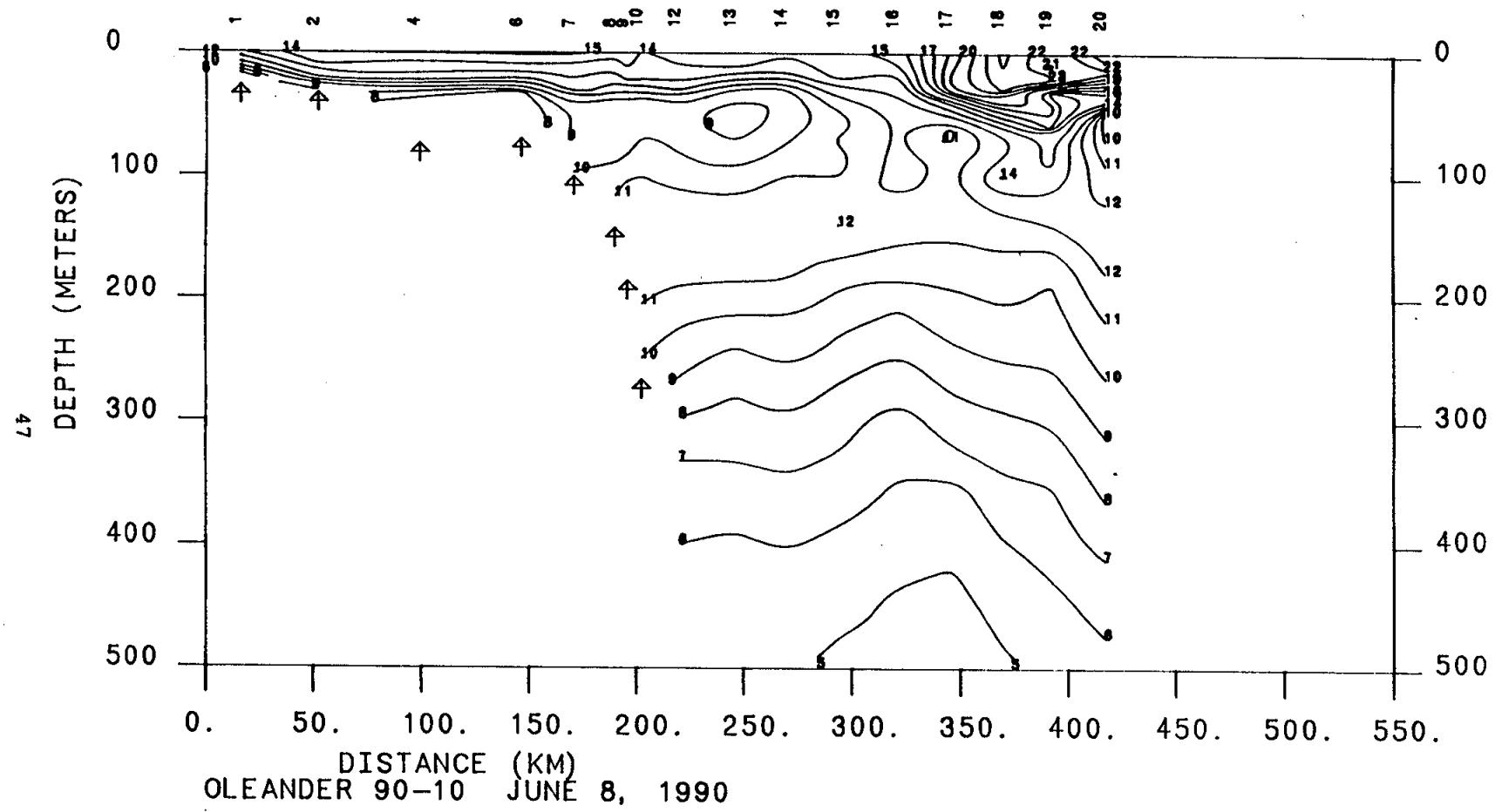


Figure 10(c). Contour plot of integer-valued isotherms to 500 m.

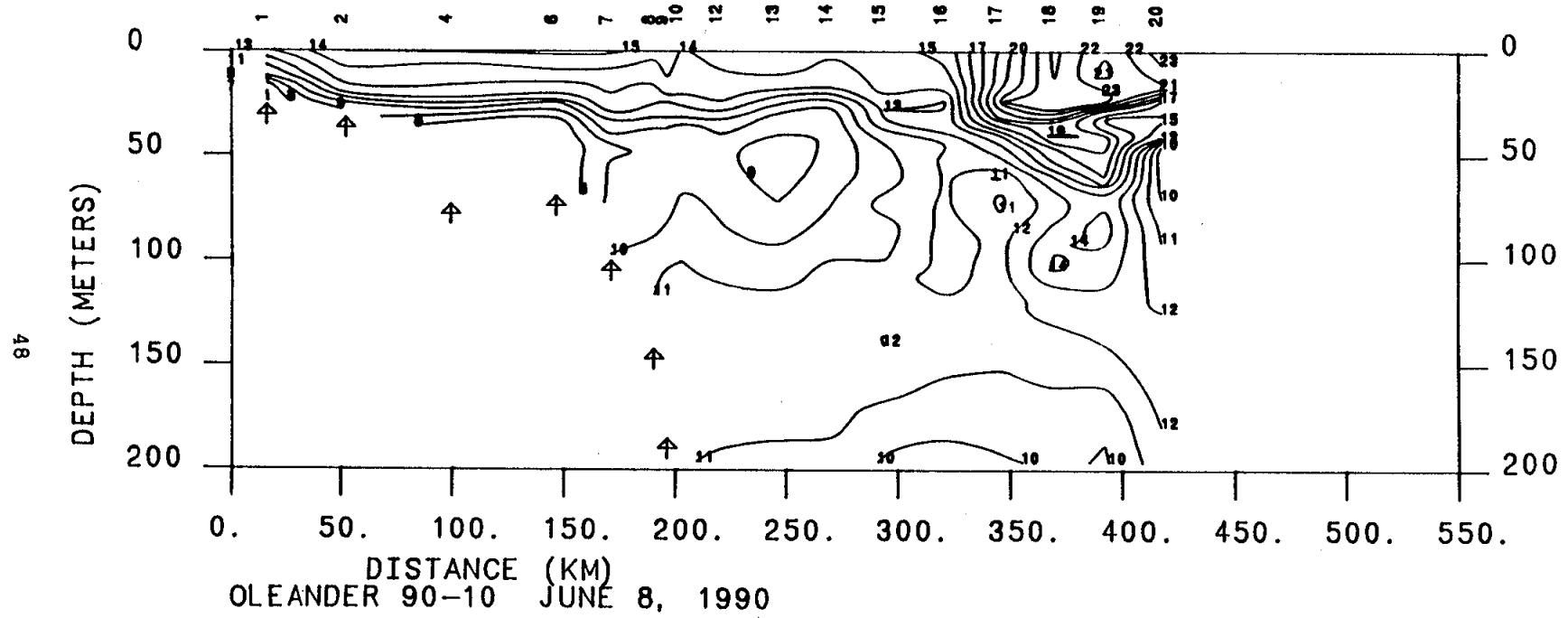


Figure 10(d). Contour plot of integer-valued isotherms to 200 m.

Figure 11. M/V *Oleander* Cruise 90-11, June 13-14, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

OS

CRUISE TRACK

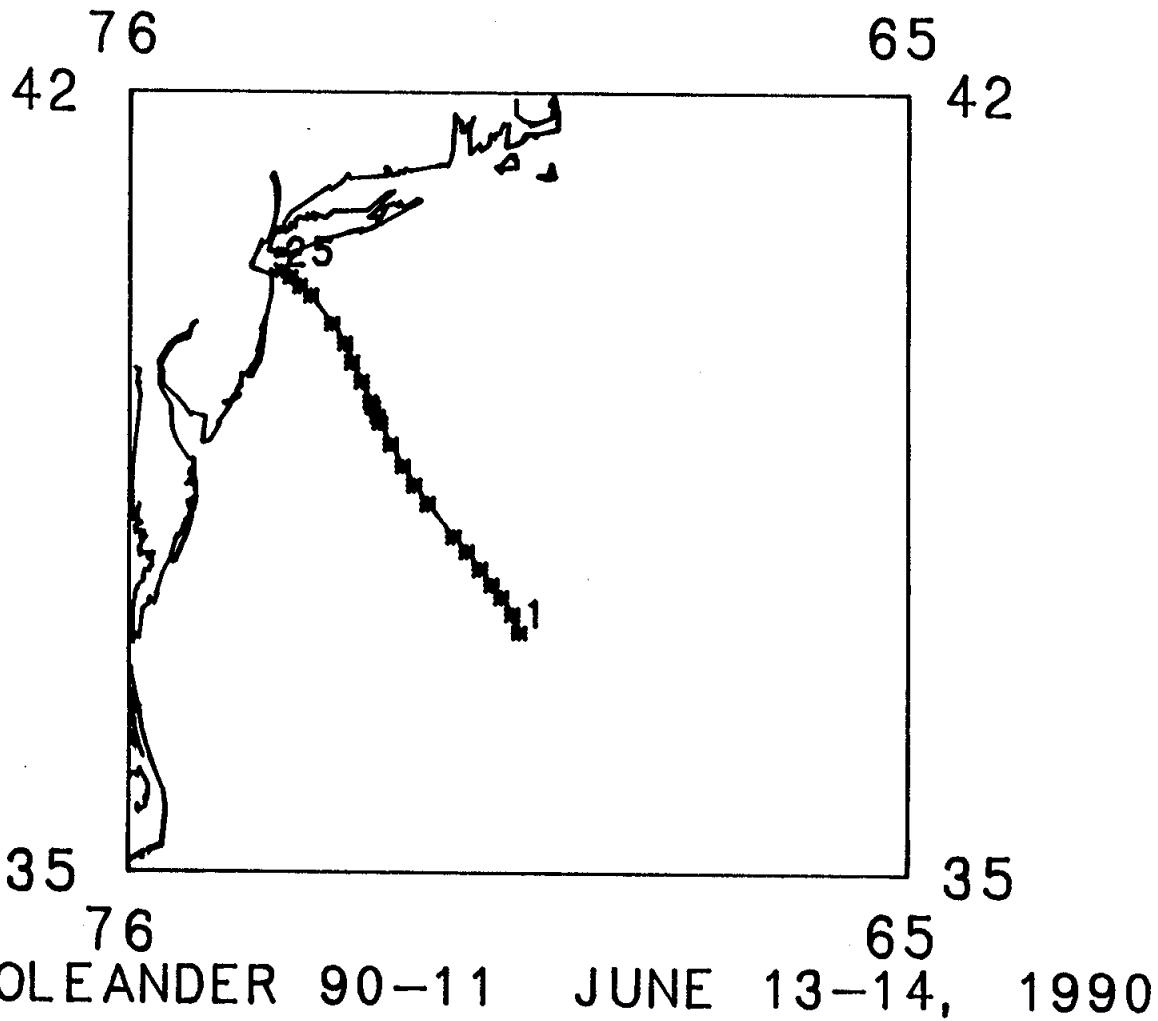


Figure 11(a). Cruise track and locations of XBT stations.

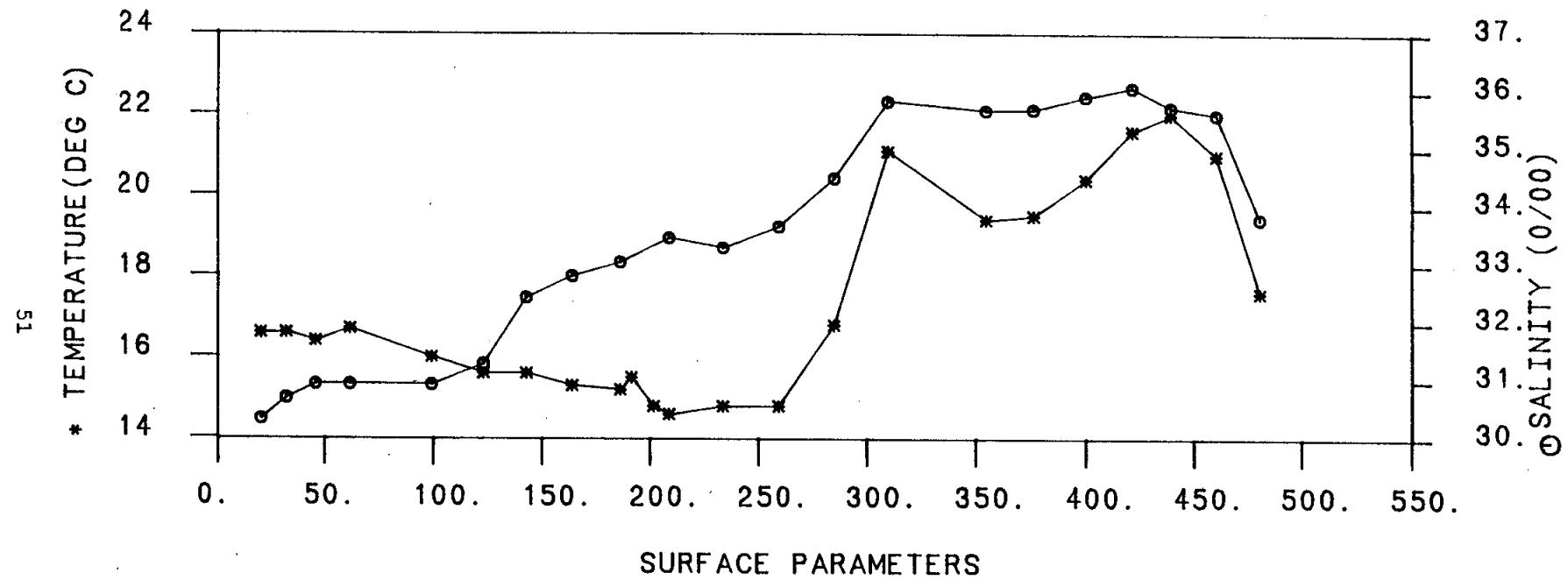


Figure 11(b). Surface temperature and salinity.

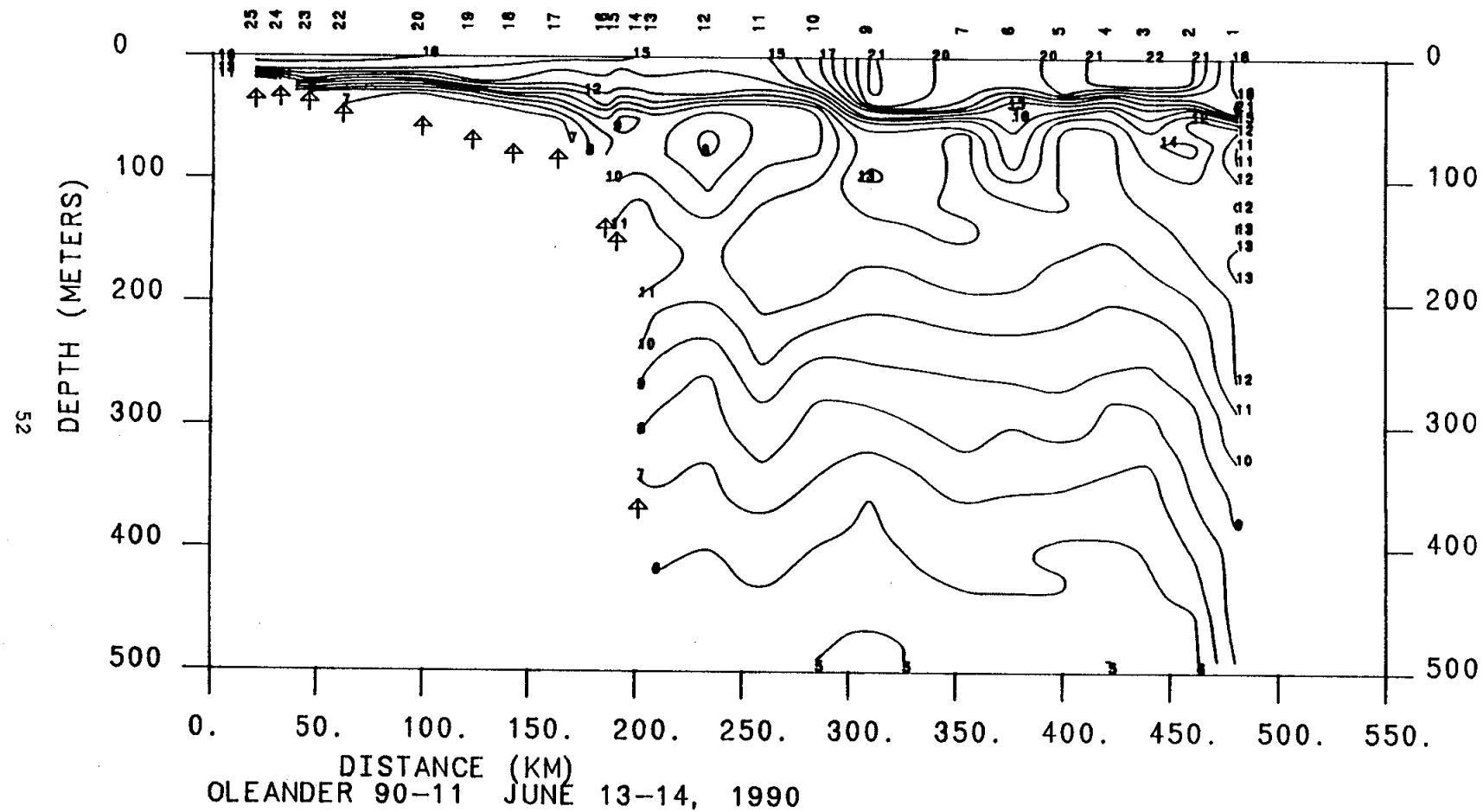


Figure 11(c). Contour plot of integer-valued isotherms to 500 m.

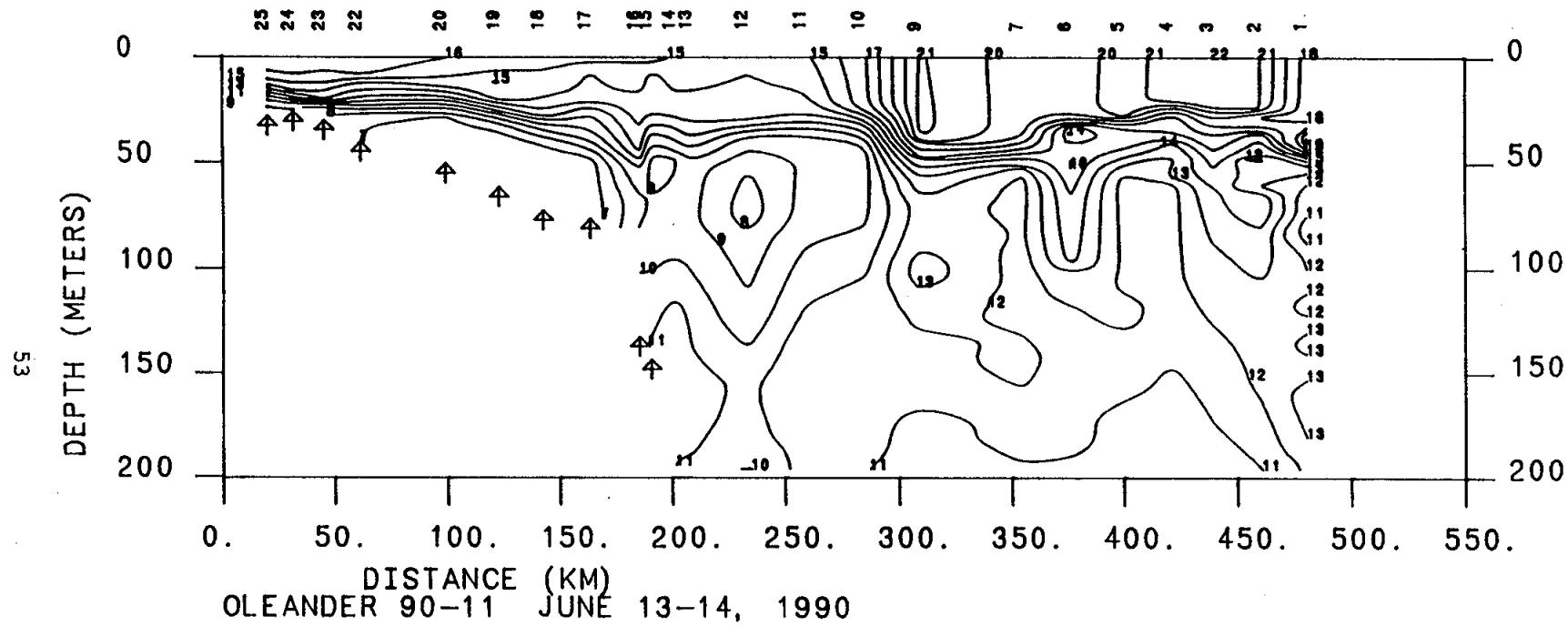


Figure 11(d). Contour plot of integer-valued isotherms to 200 m.

Figure 12. M/V *Oleander* Cruise 90-12, June 22, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

SS

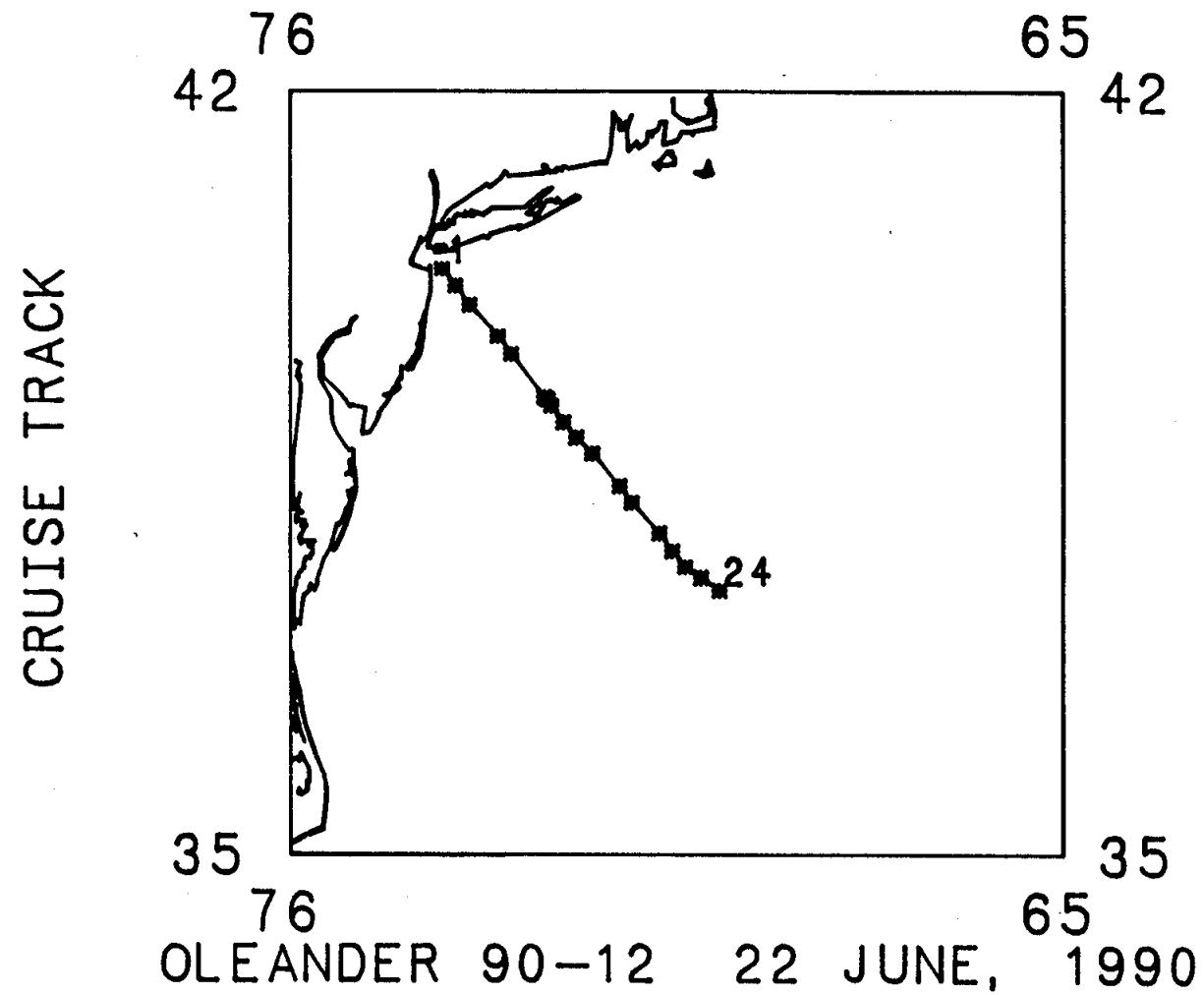


Figure 12(a). Cruise track and locations of XBT stations.

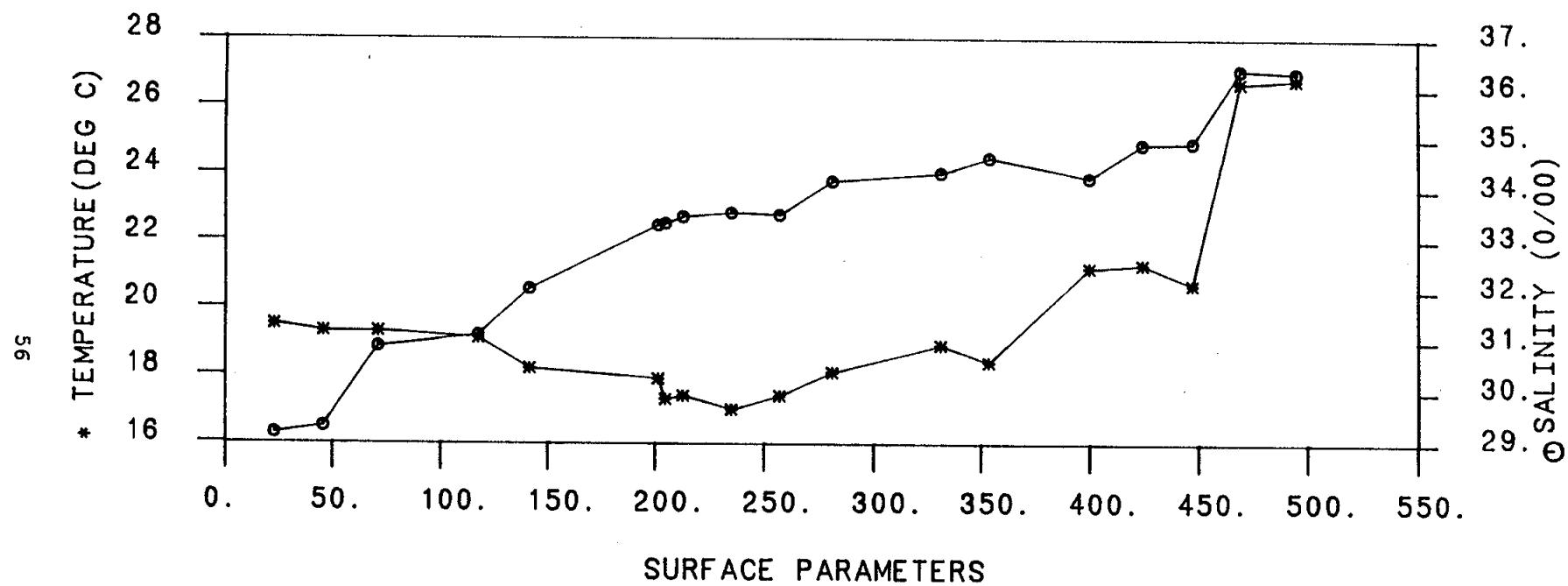


Figure 12(b). Surface temperature and salinity.

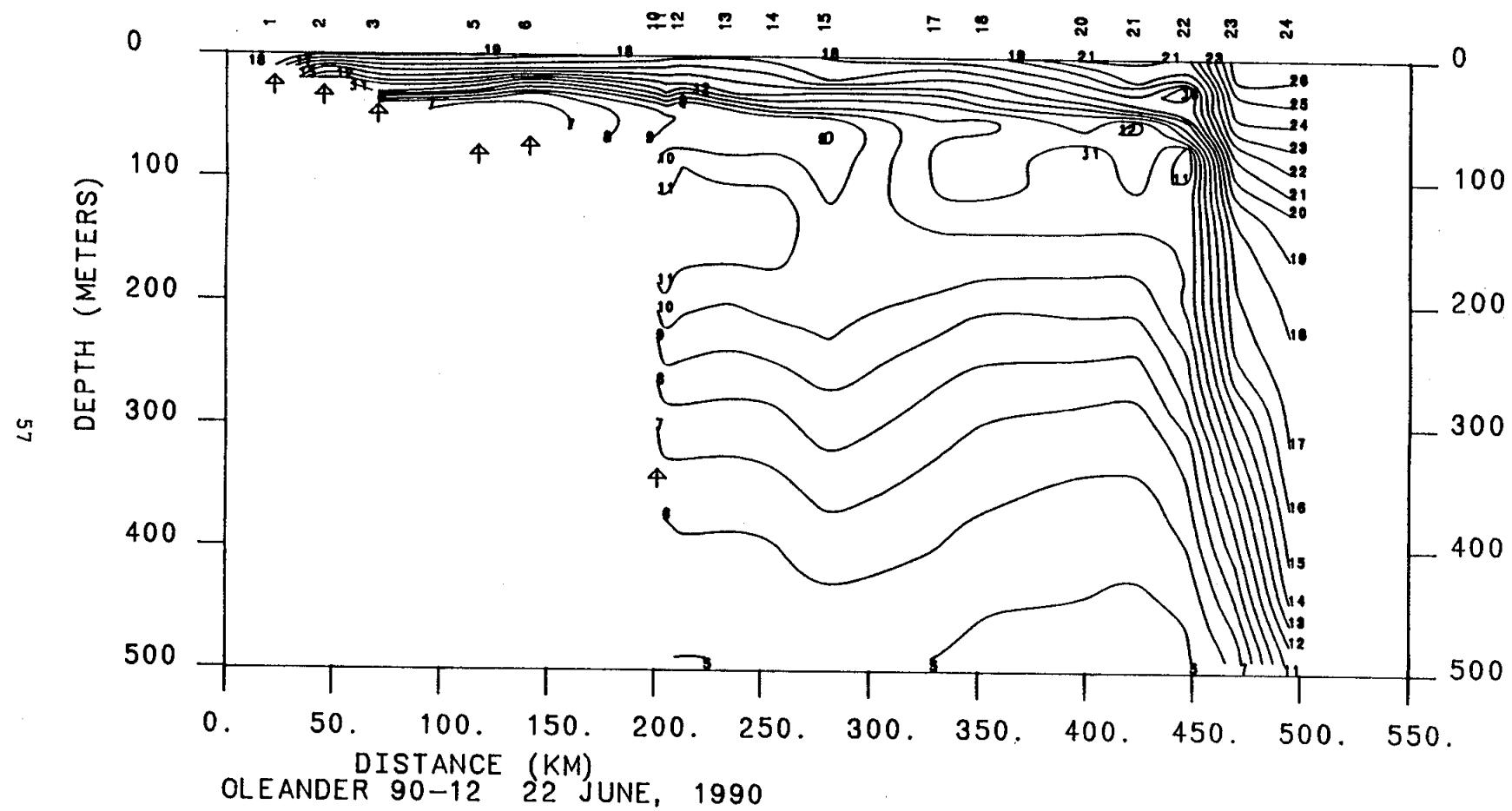


Figure 12(c). Contour plot of integer-valued isotherms to 500 m.

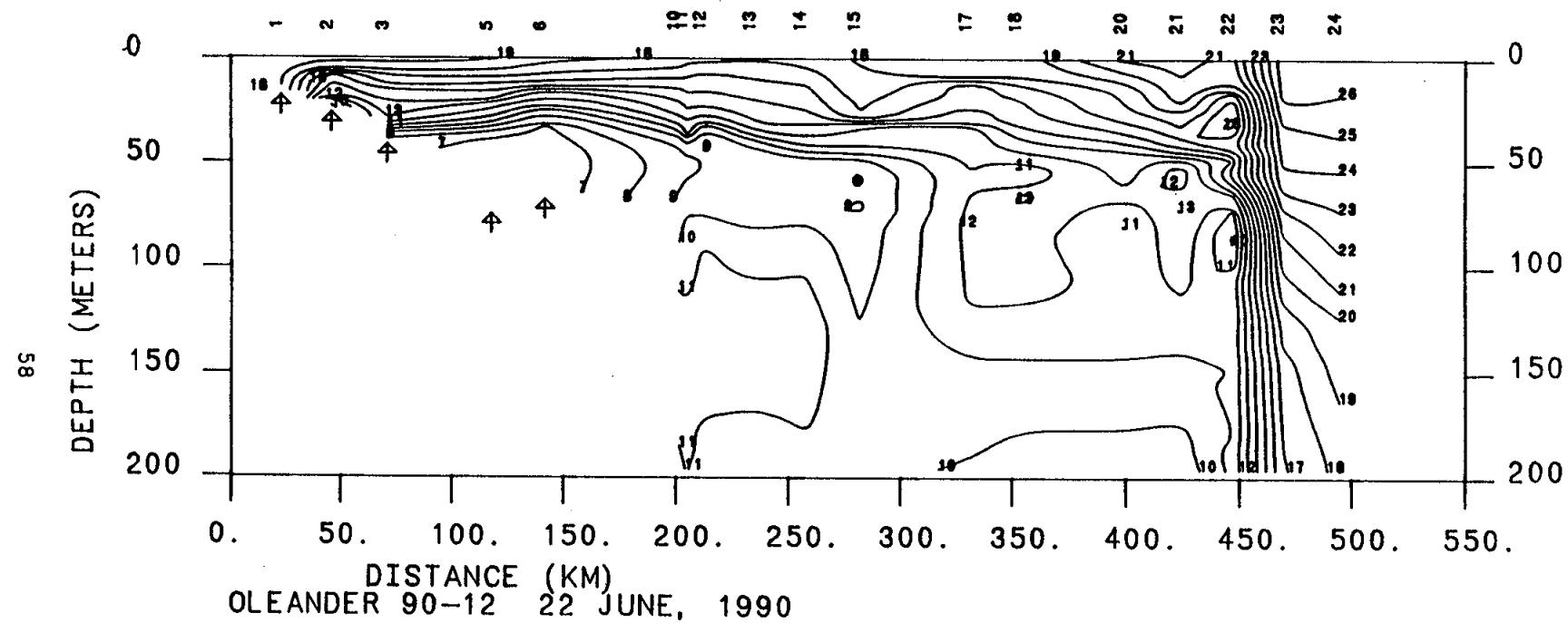


Figure 12(d). Contour plot of integer-valued isotherms to 200 m.

Figure 13. M/V *Oleander* Cruise 90-13, June 27-28, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

09

CRUISE TRACK

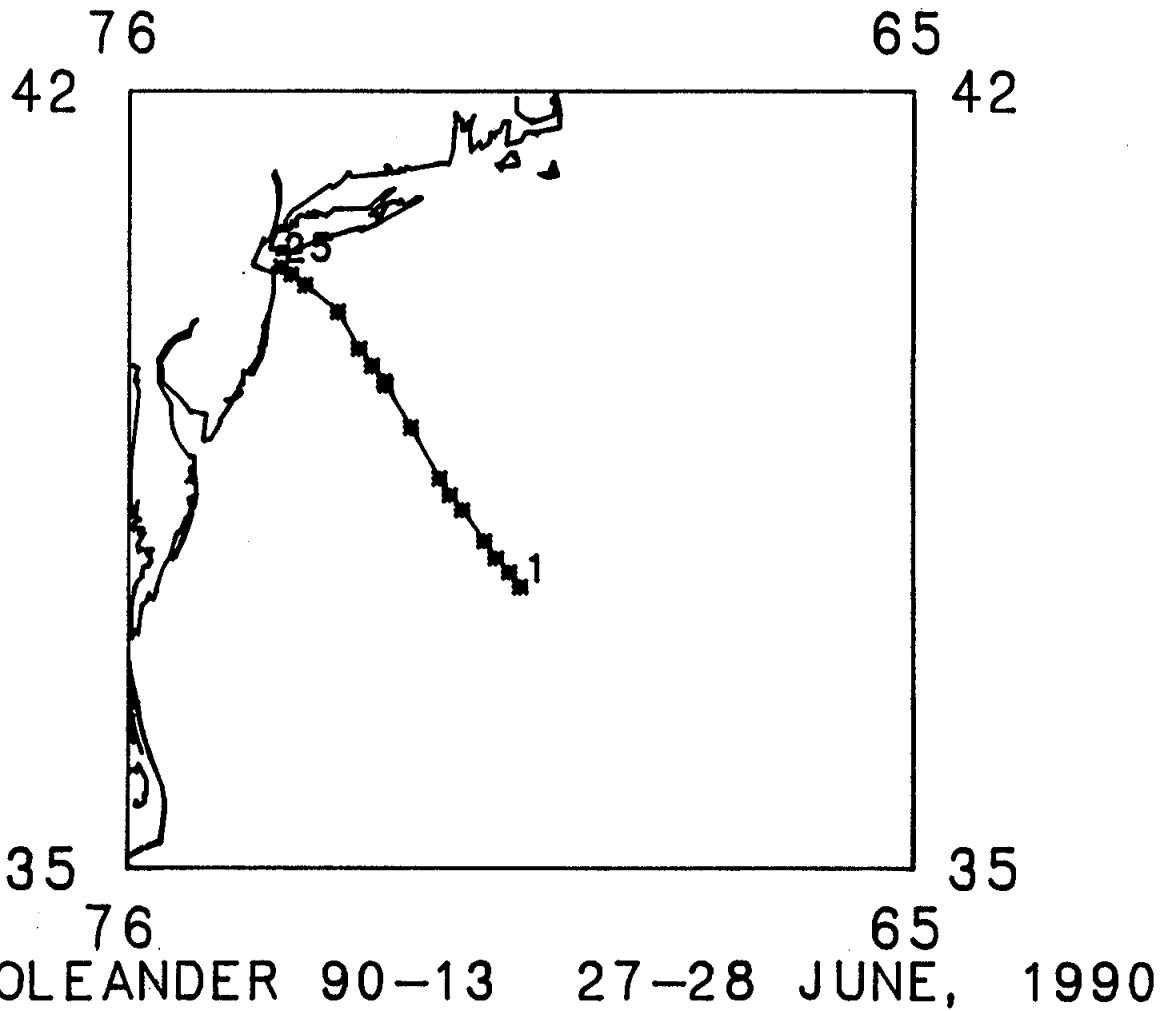


Figure 13(a). Cruise track and locations of XBT stations.

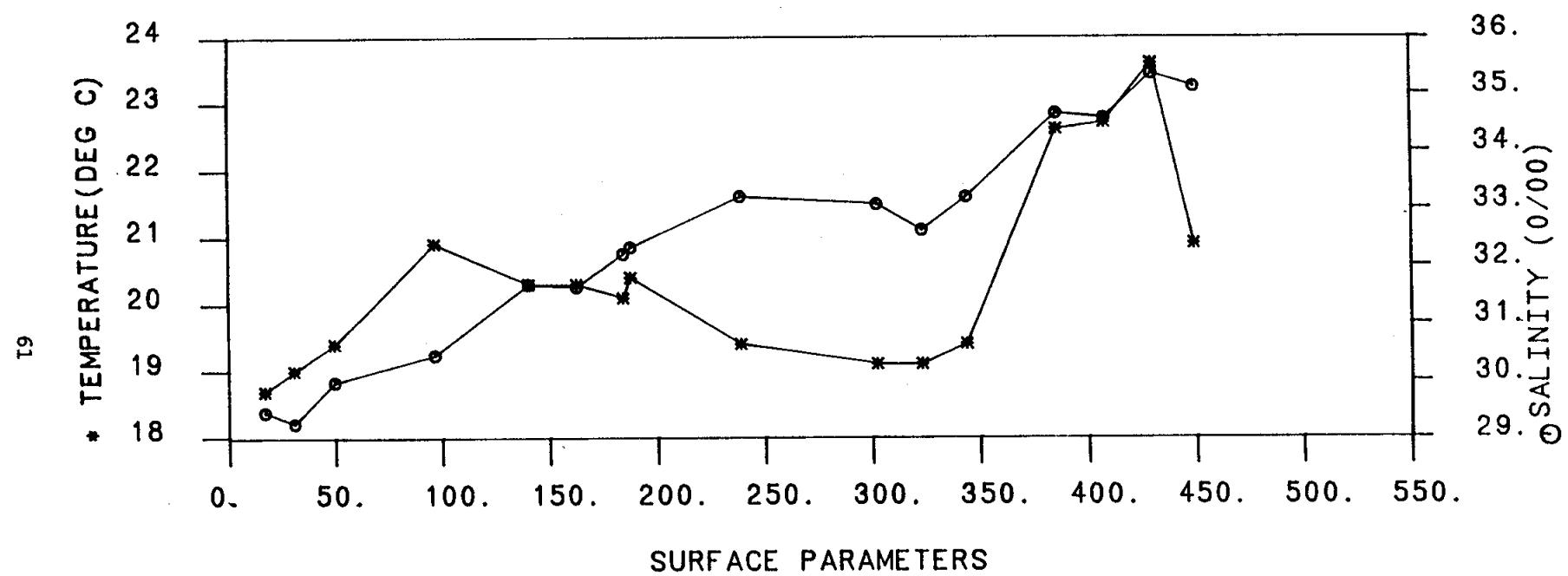


Figure 13(b). Surface temperature and salinity.

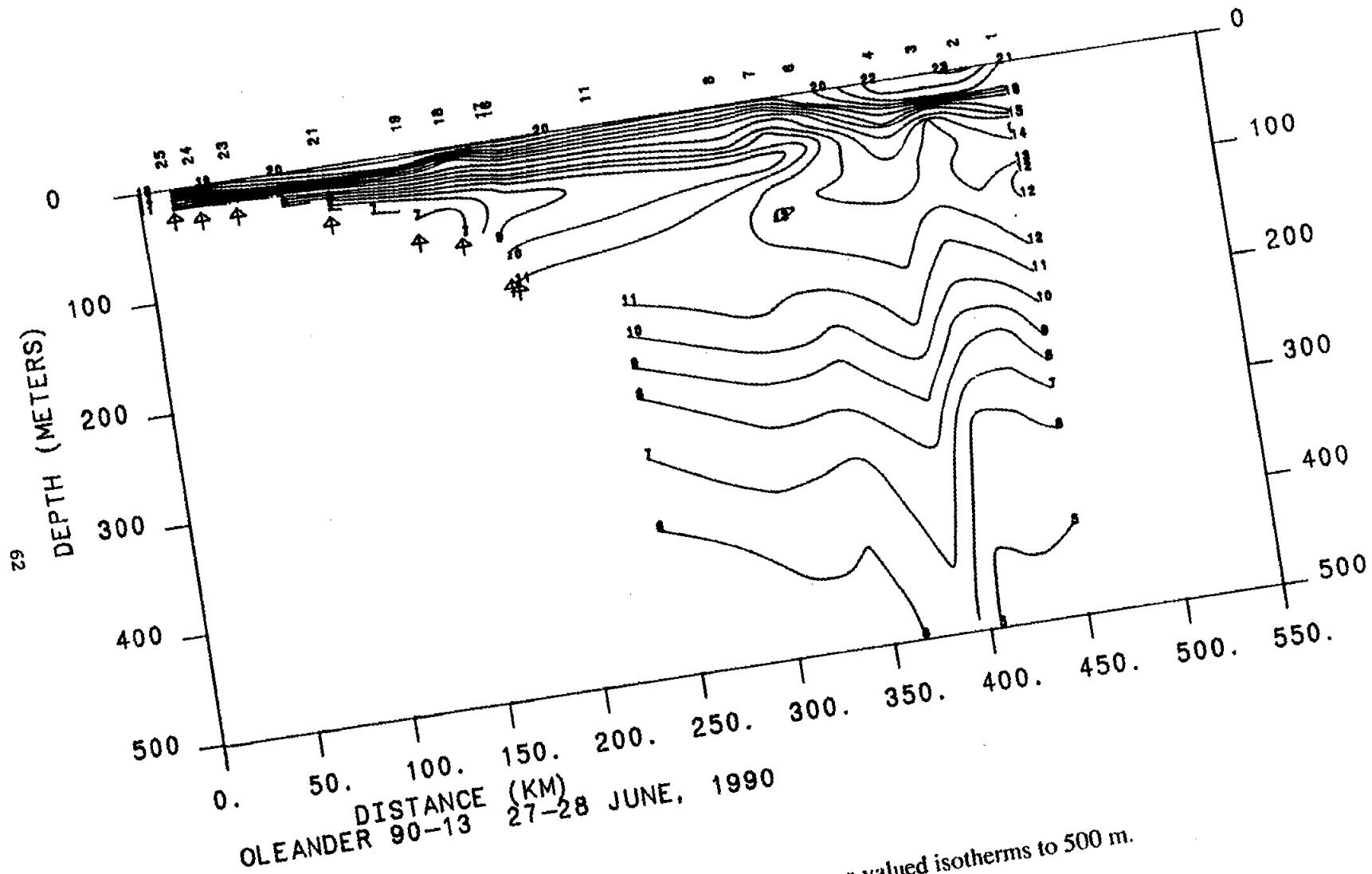


Figure 13(c). Contour plot of integer-valued isotherms to 500 m.

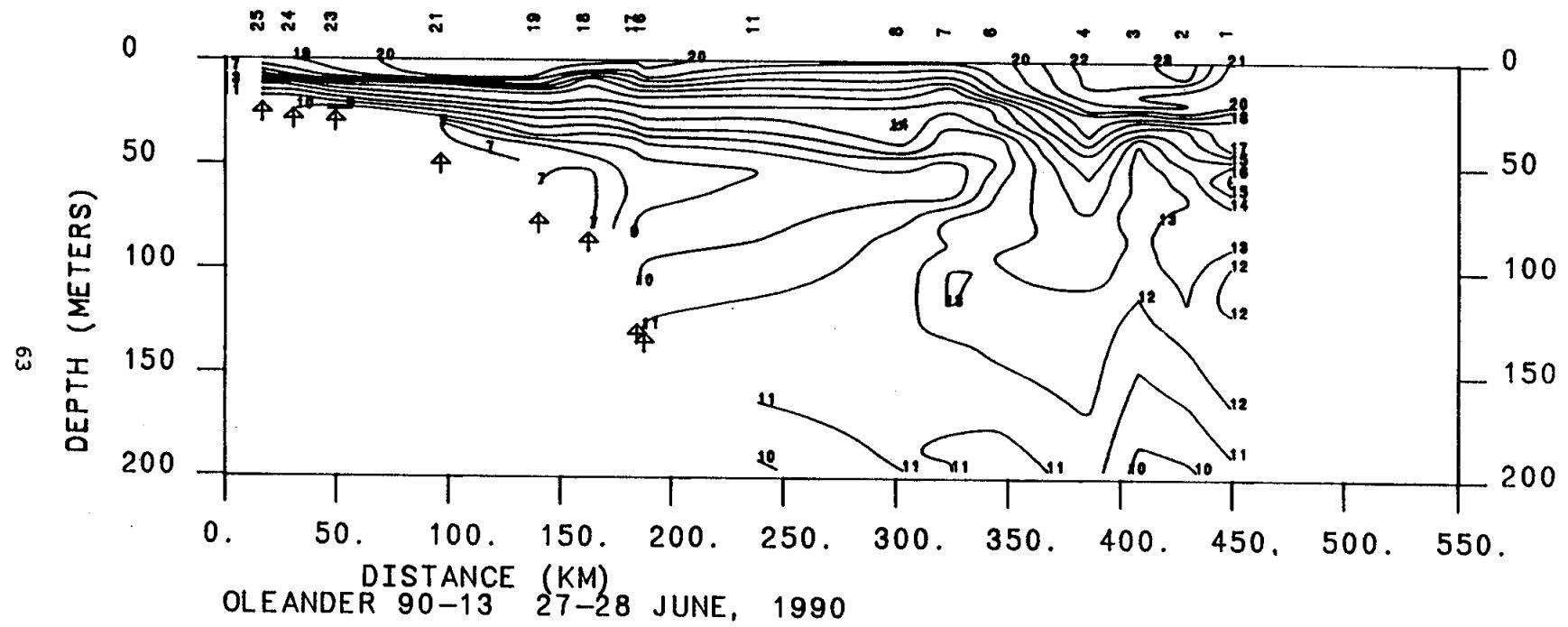


Figure 13(d). Contour plot of integer-valued isotherms to 200 m.

Figure 14. M/V *Oleander* Cruise 90-14, July 6, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

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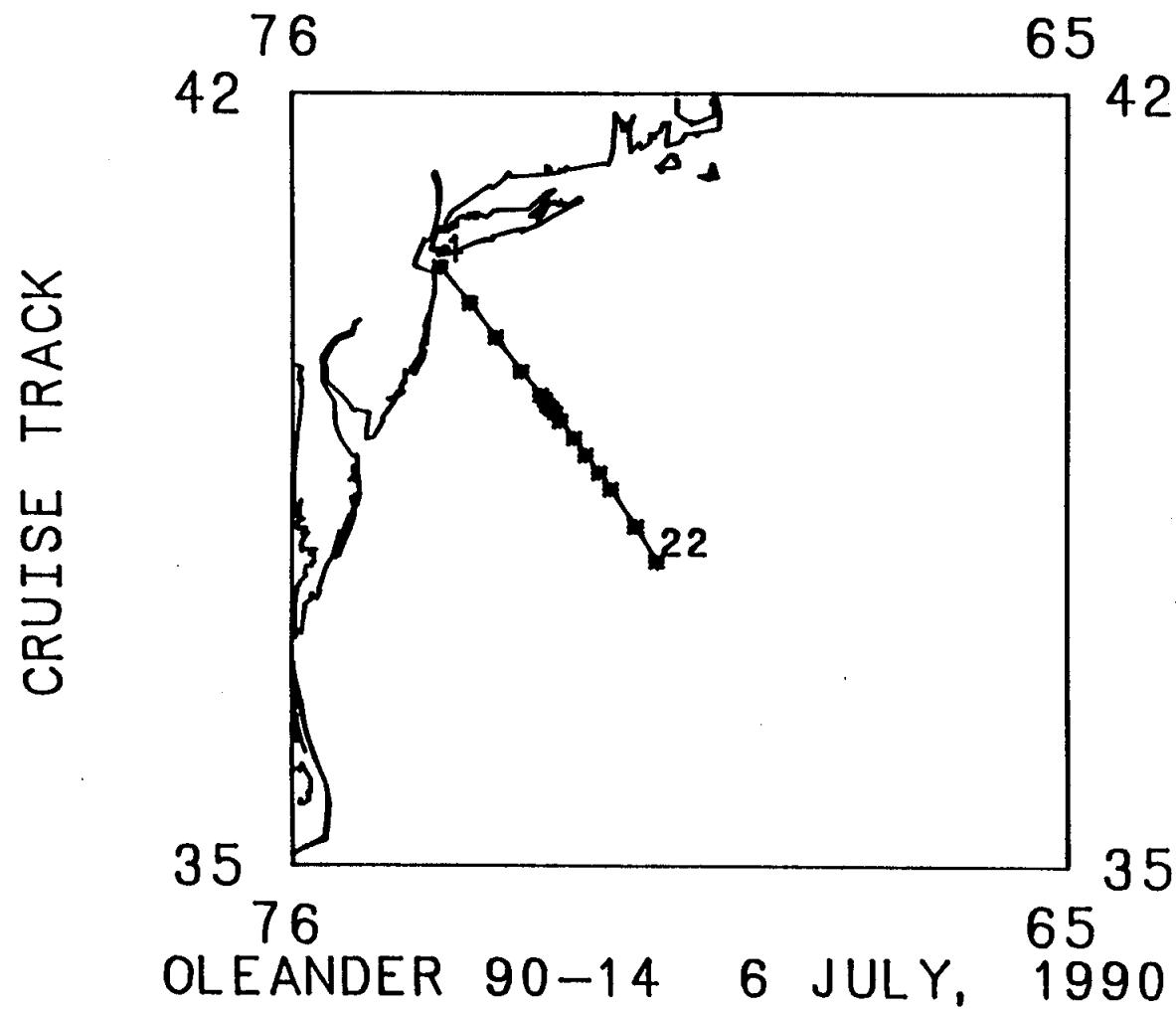


Figure 14(a). Cruise track and locations of XBT stations.

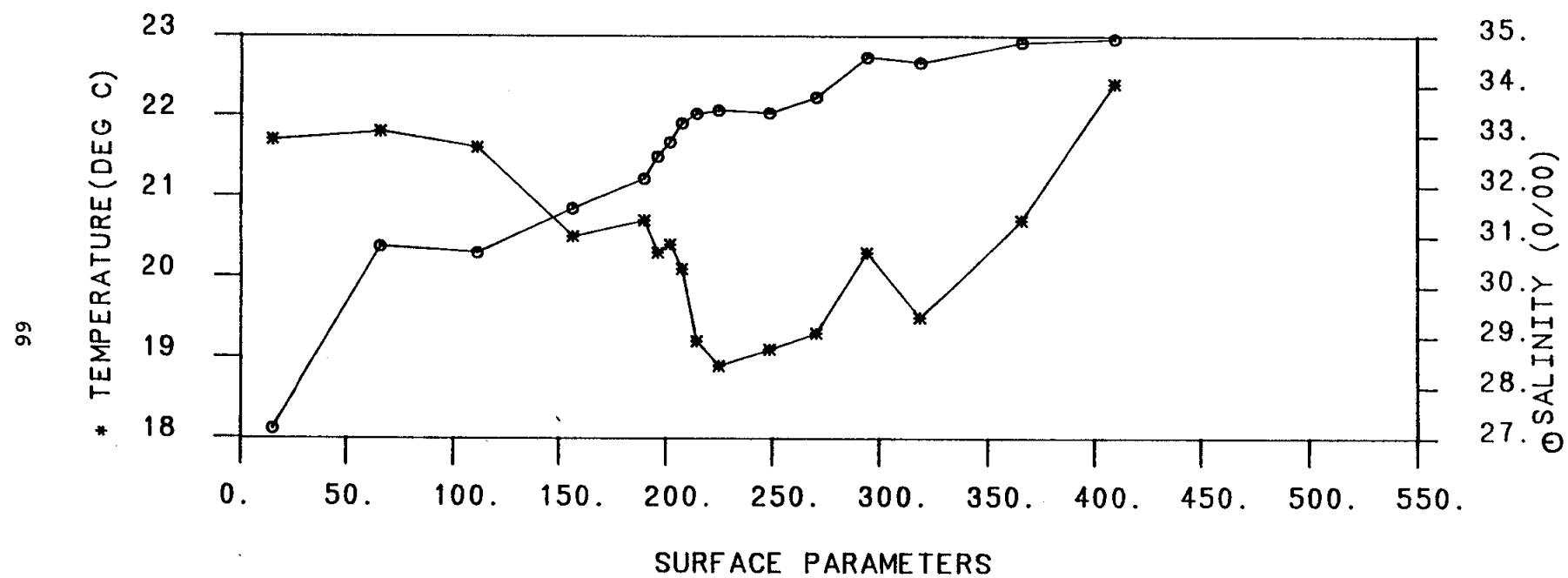


Figure 14(b). Surface temperature and salinity.

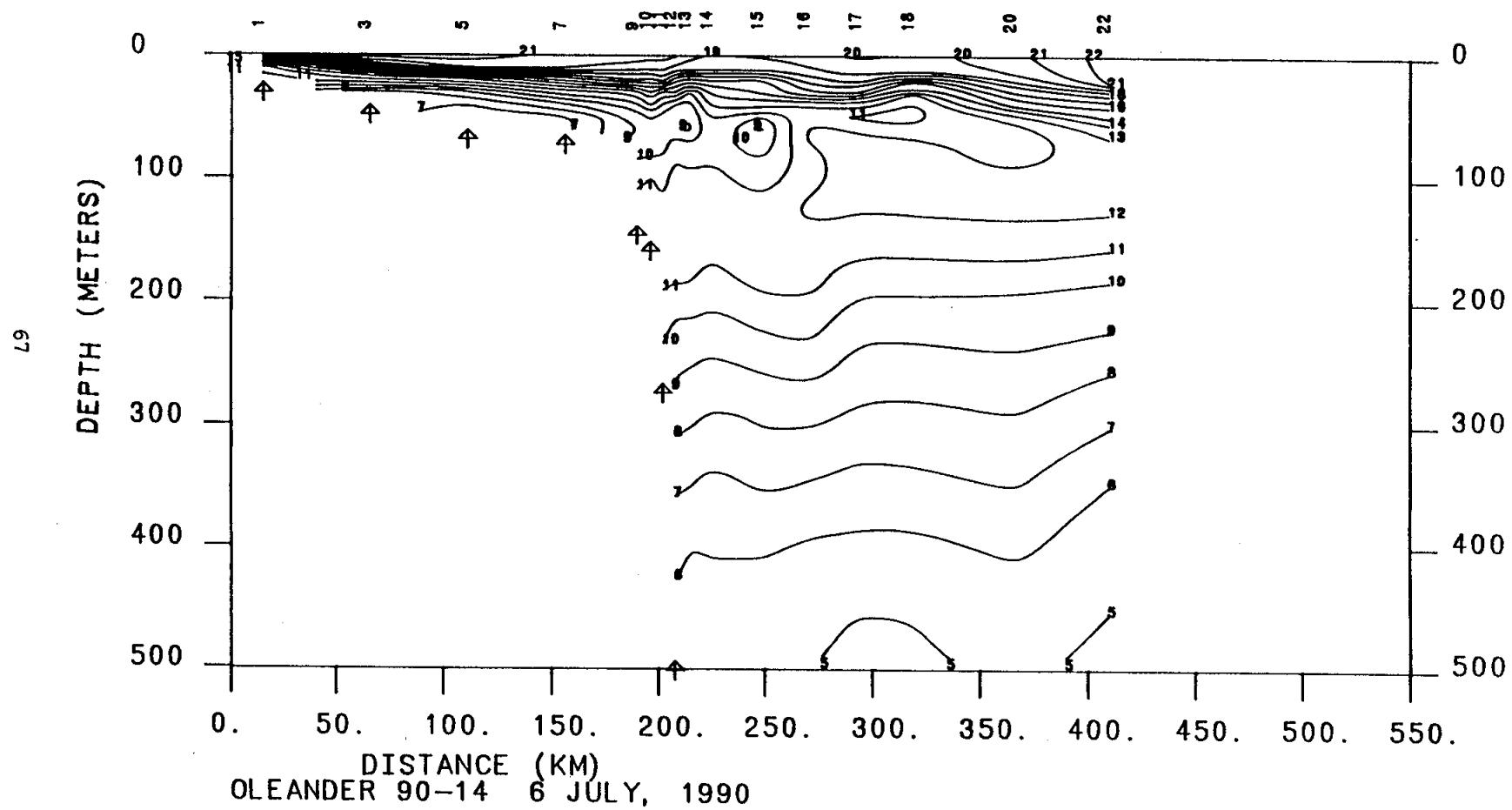


Figure 14(c). Contour plot of integer-valued isotherms to 500 m.

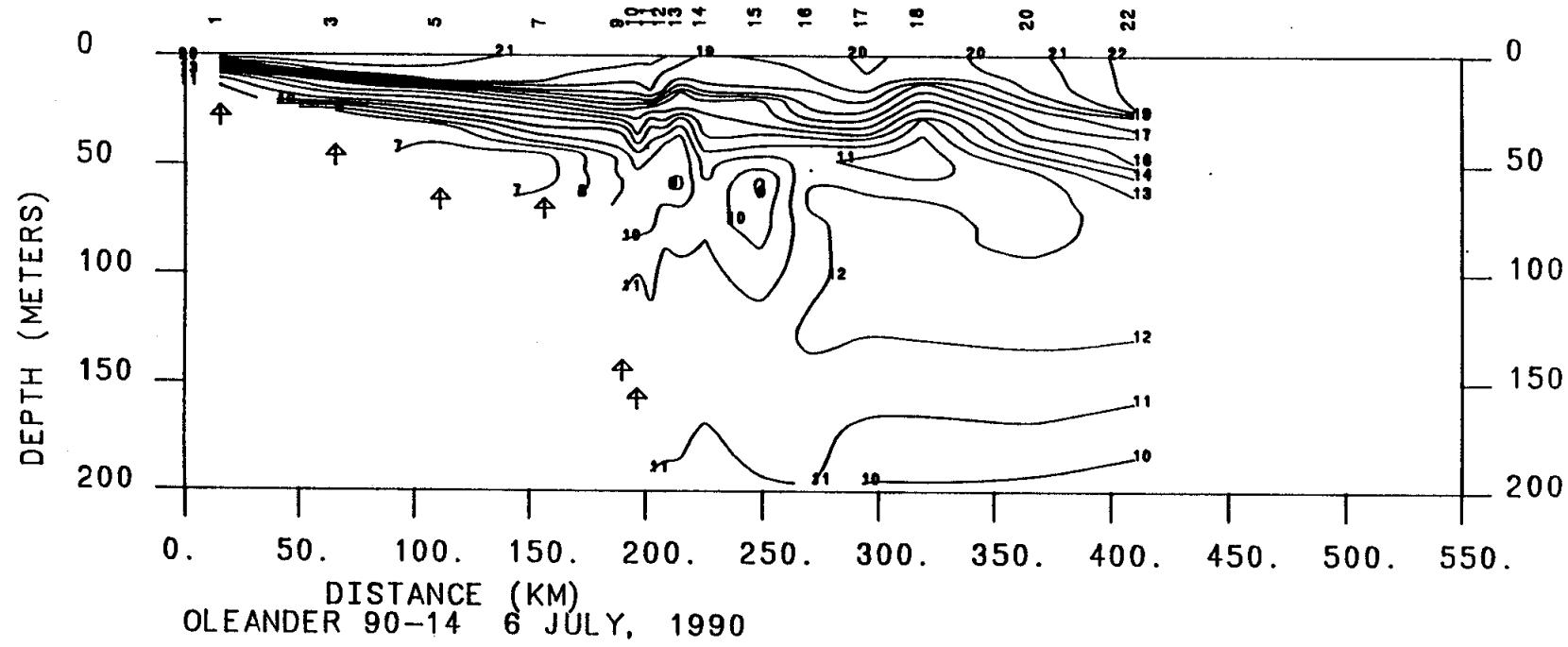


Figure 14(d). Contour plot of integer-valued isotherms to 200 m.

Figure 15. M/V *Oleander* Cruise 90-15, July 11-12, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

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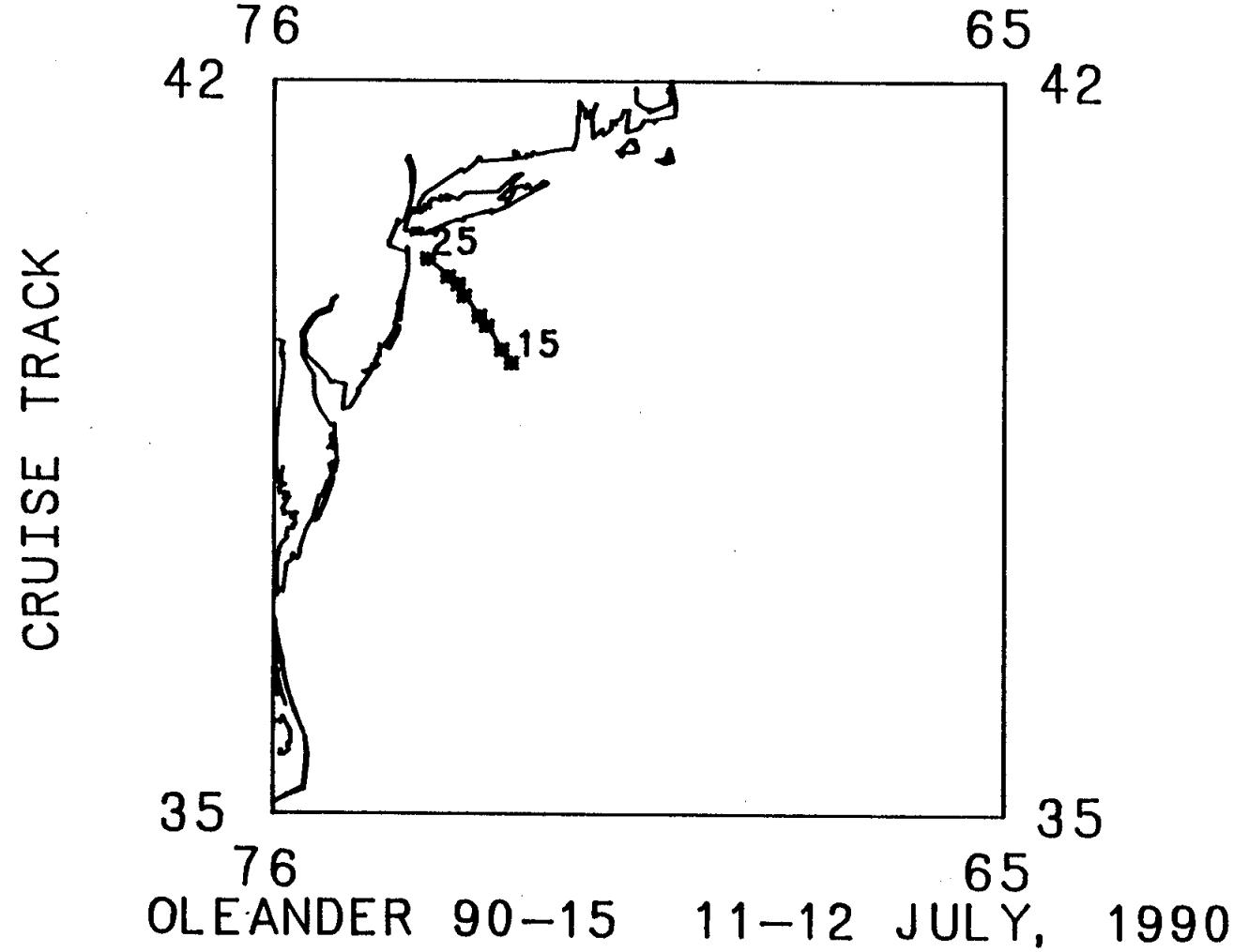


Figure 15(a). Cruise track and locations of XBT stations.

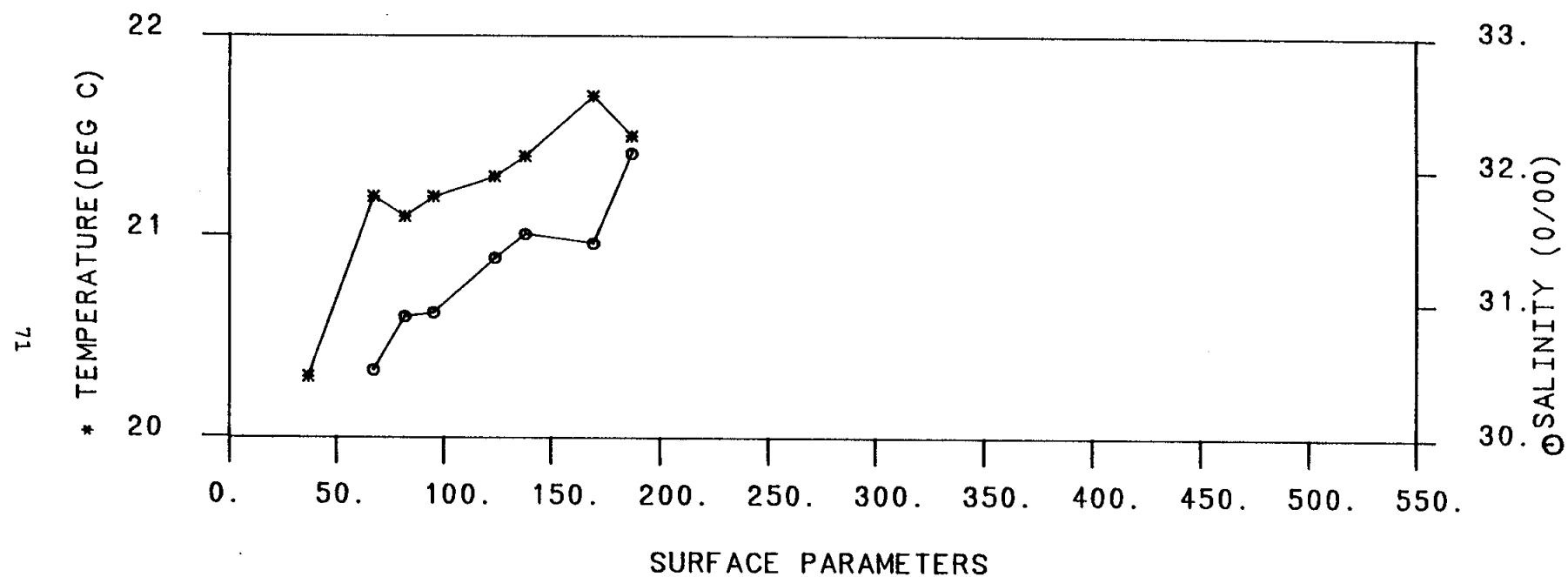


Figure 15(b). Surface temperature and salinity.

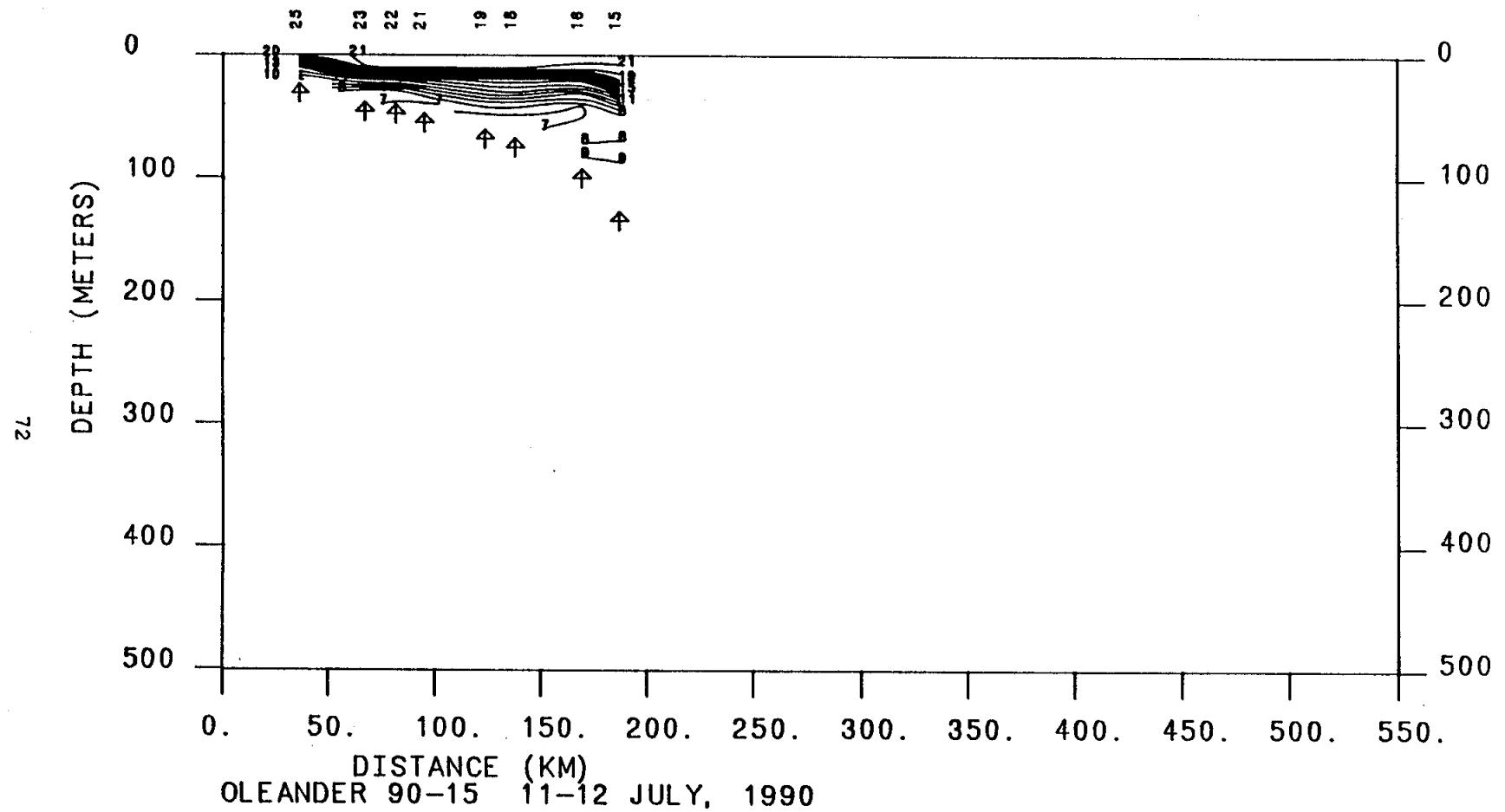


Figure 15(c). Contour plot of integer-valued isotherms to 500 m.

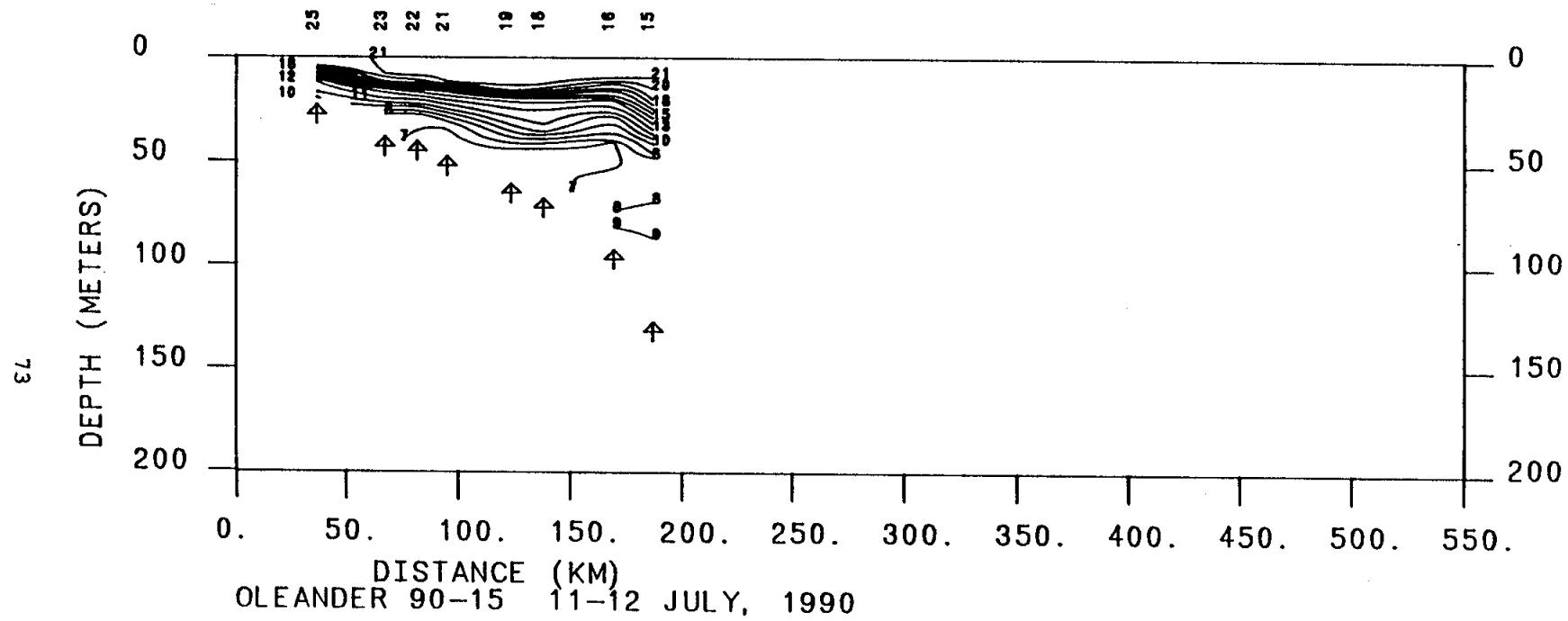


Figure 15(d). Contour plot of integer-valued isotherms to 200 m.

Figure 16. M/V *Oleander* Cruise 90-16, July 20, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

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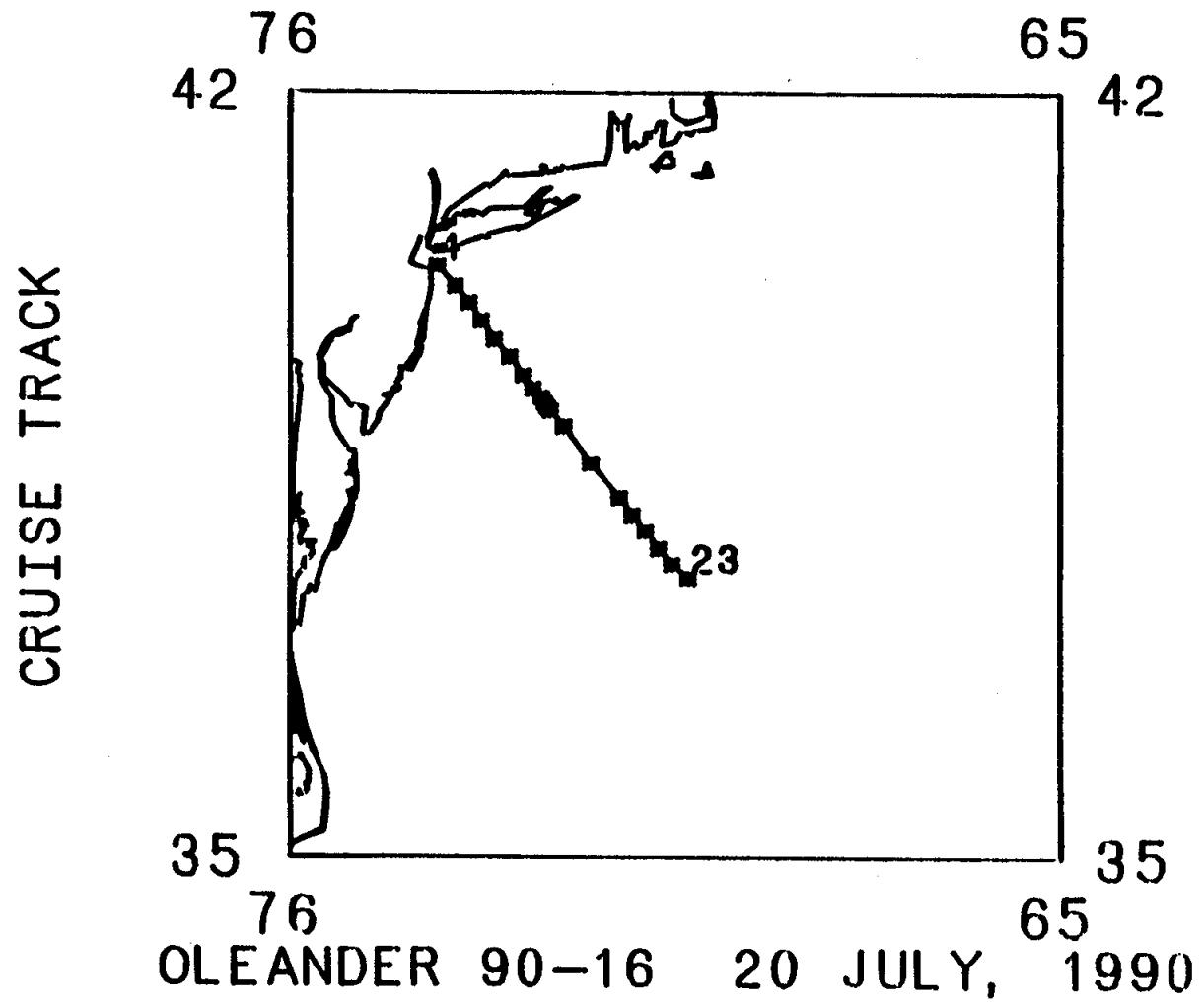


Figure 16(a). Cruise track and locations of XBT stations.

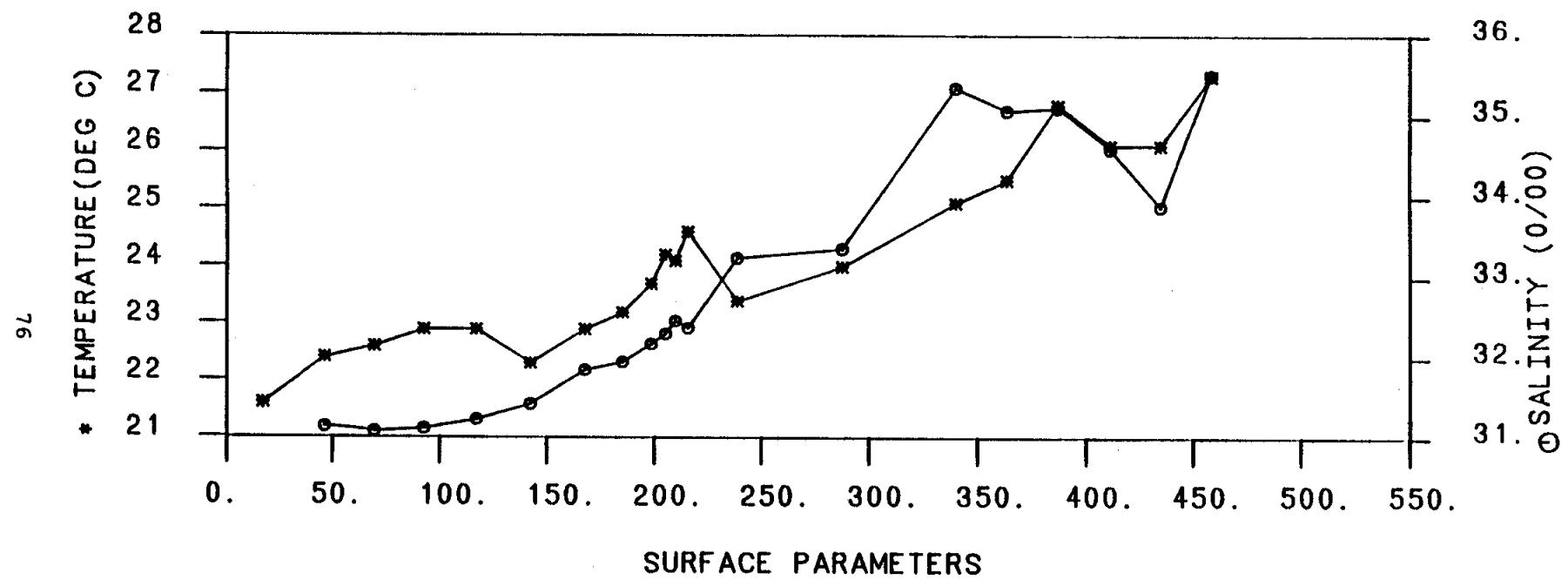


Figure 16(b). Surface temperature and salinity.

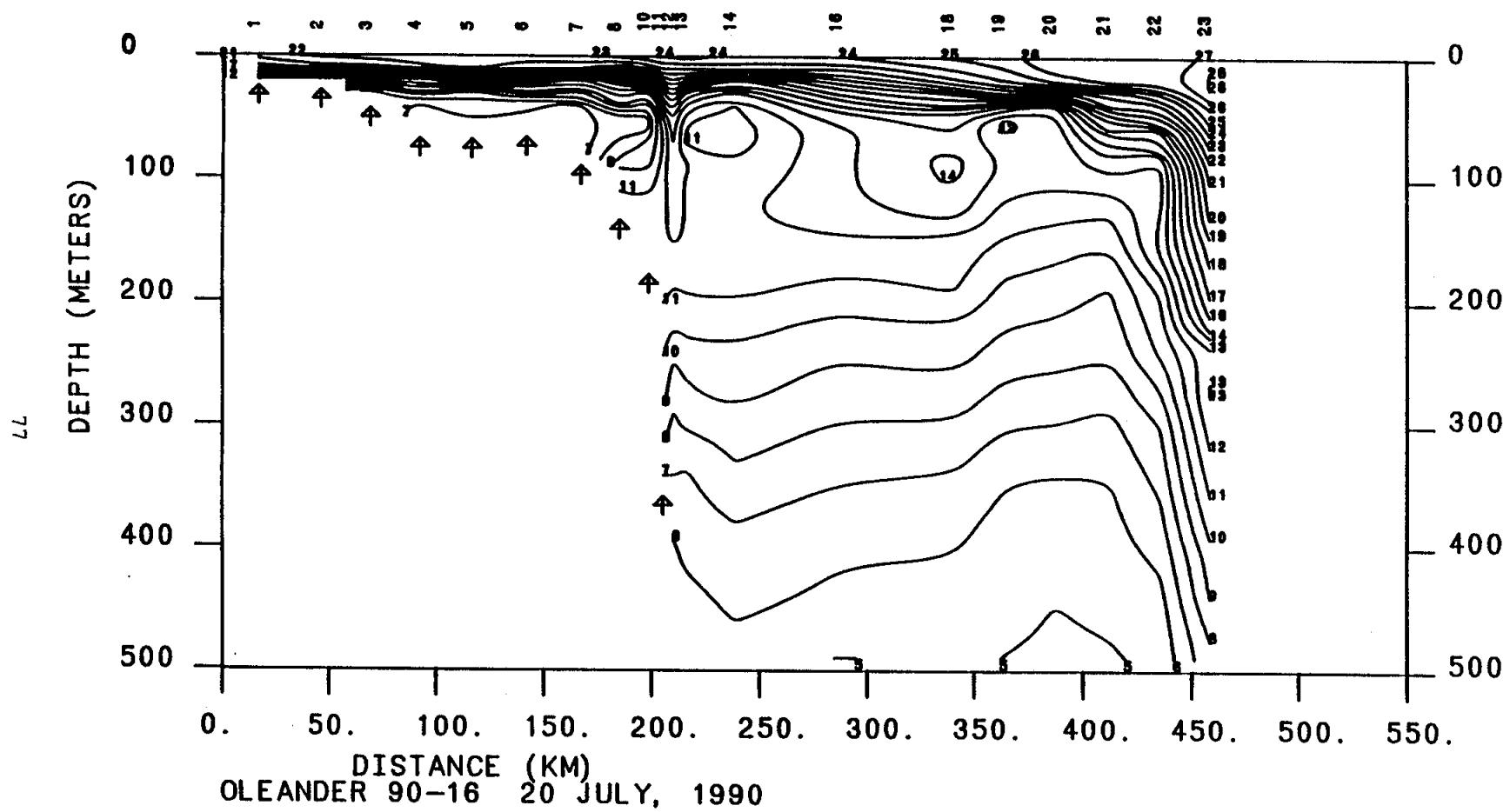


Figure 16(c). Contour plot of integer-valued isotherms to 500 m.

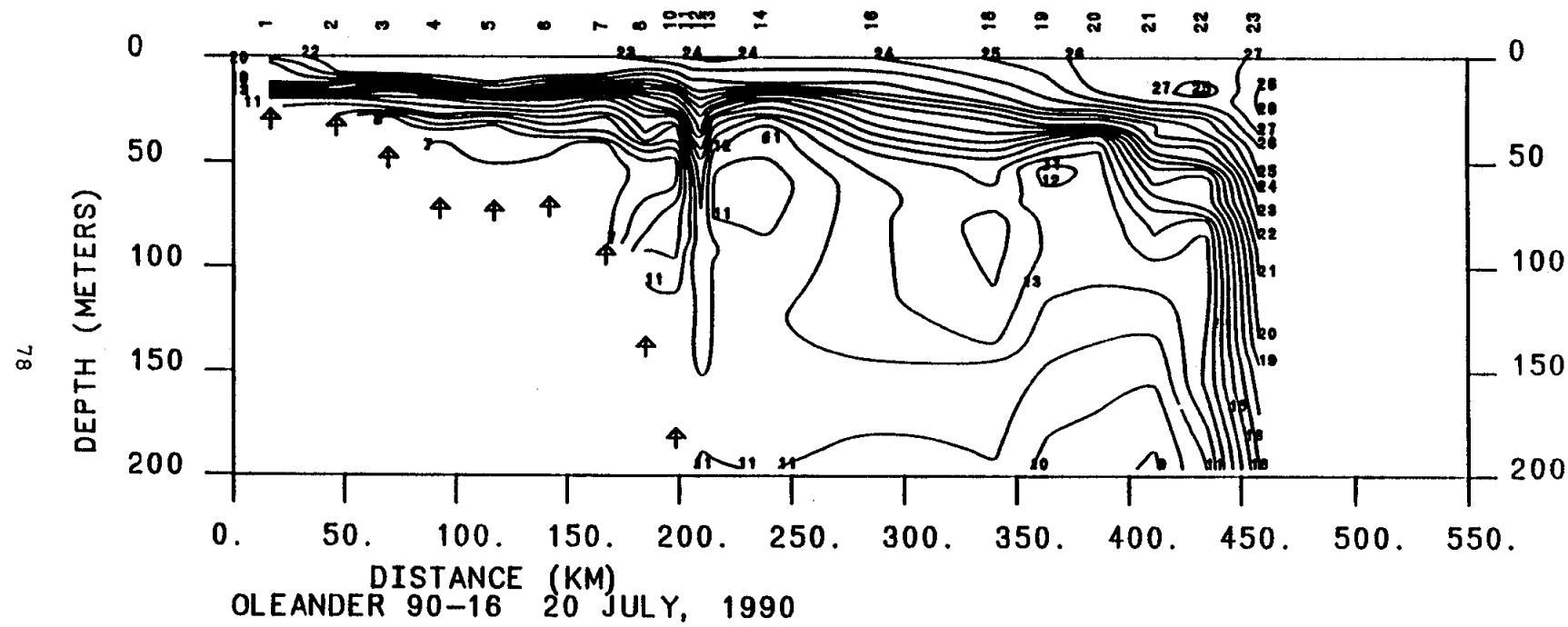


Figure 16(d). Contour plot of integer-valued isotherms to 200 m.

Figure 17. M/V *Oleander* Cruise 90-17, July 25-26, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

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CRUISE TRACK

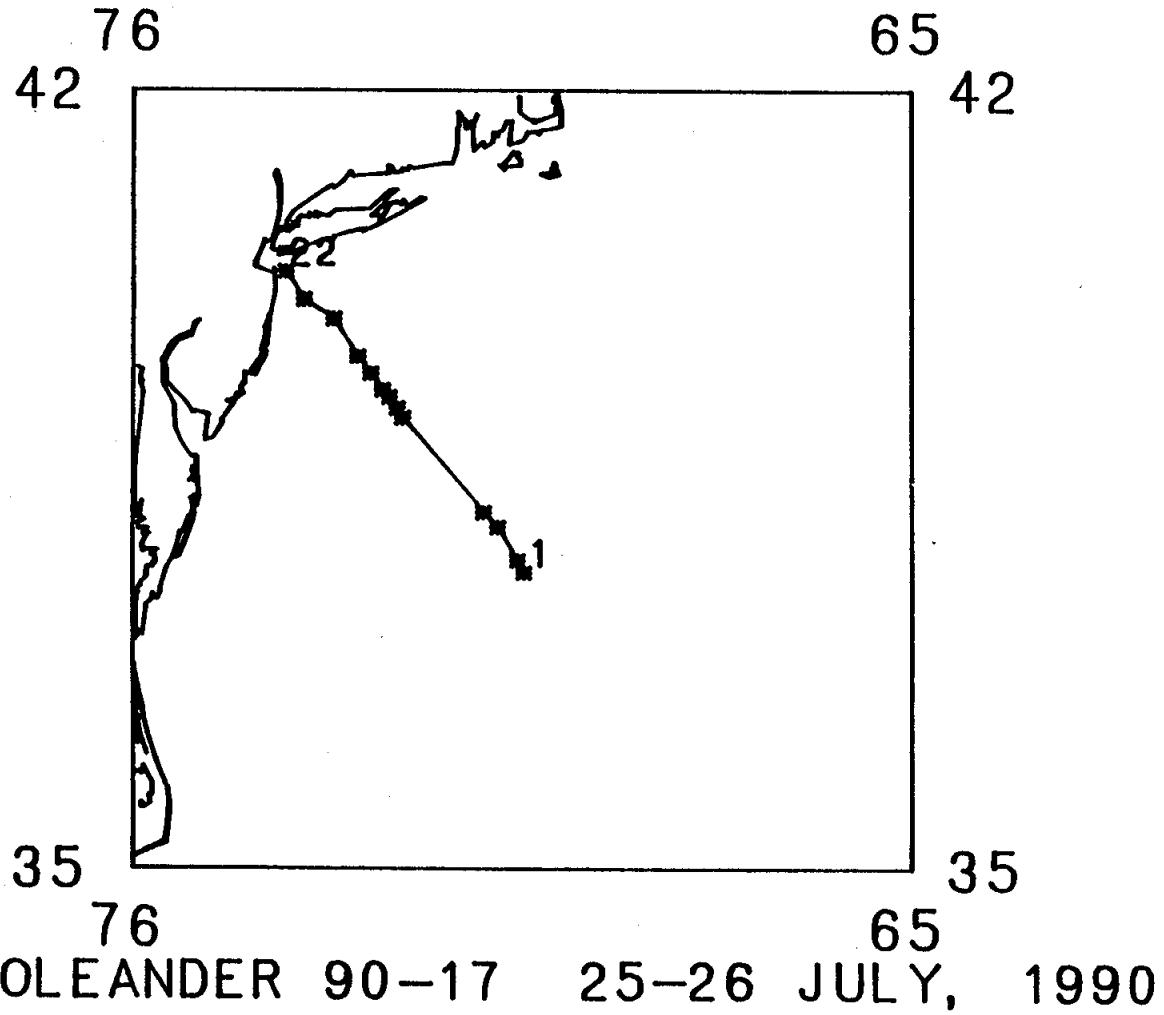


Figure 17(a). Cruise track and locations of XBT stations.

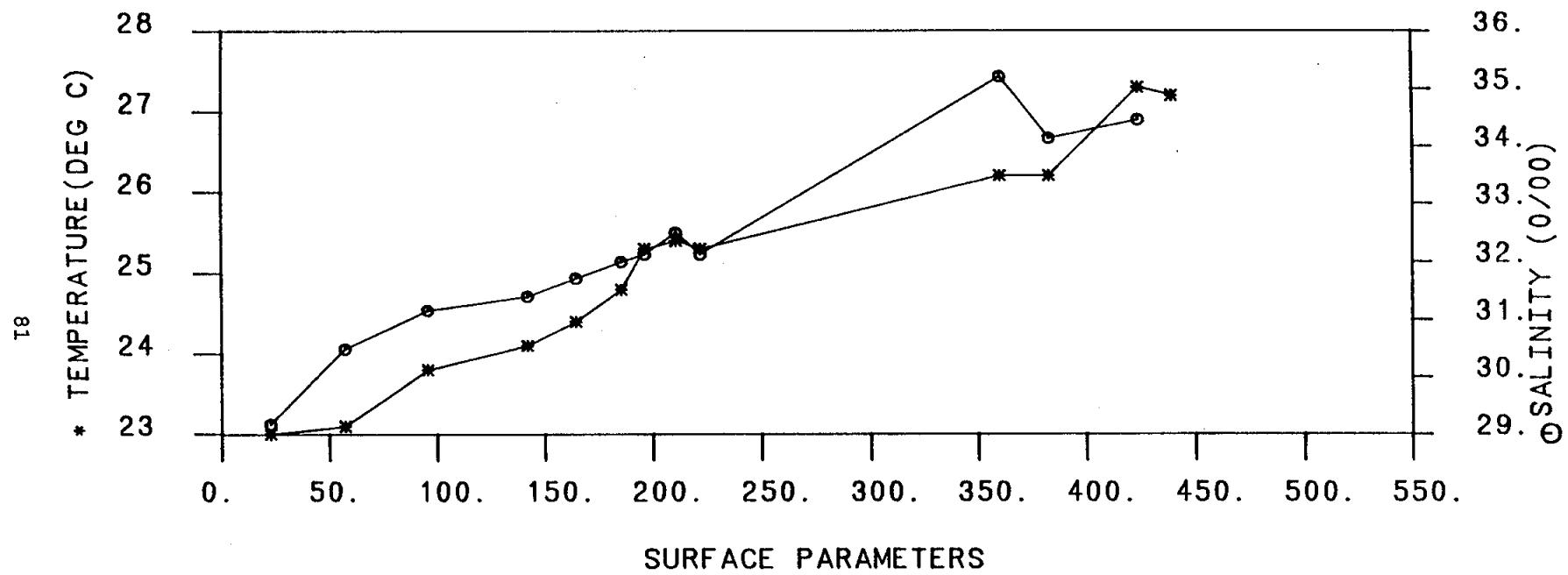


Figure 17(b). Surface temperature and salinity.

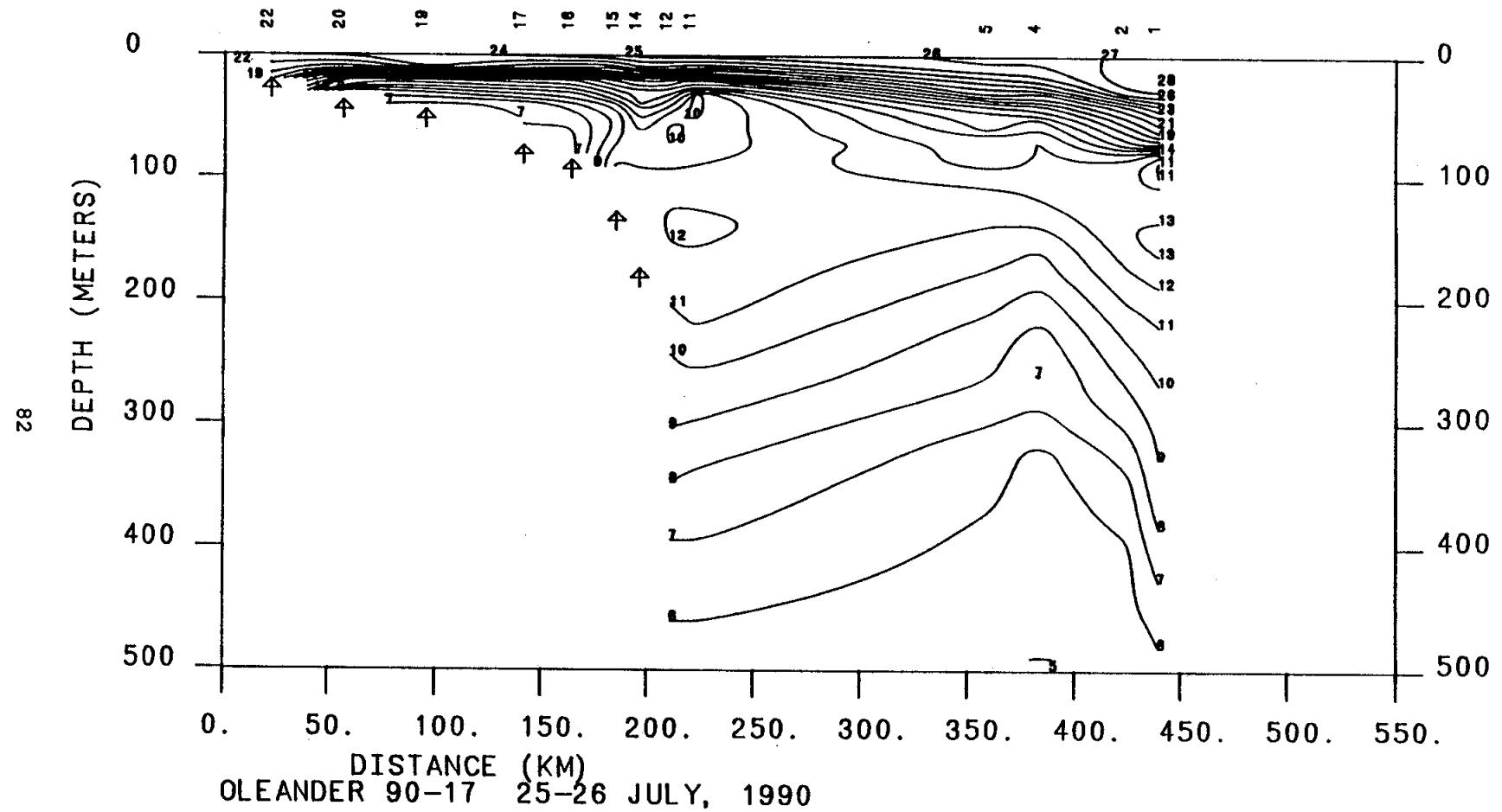


Figure 17(c). Contour plot of integer-valued isotherms to 500 m.

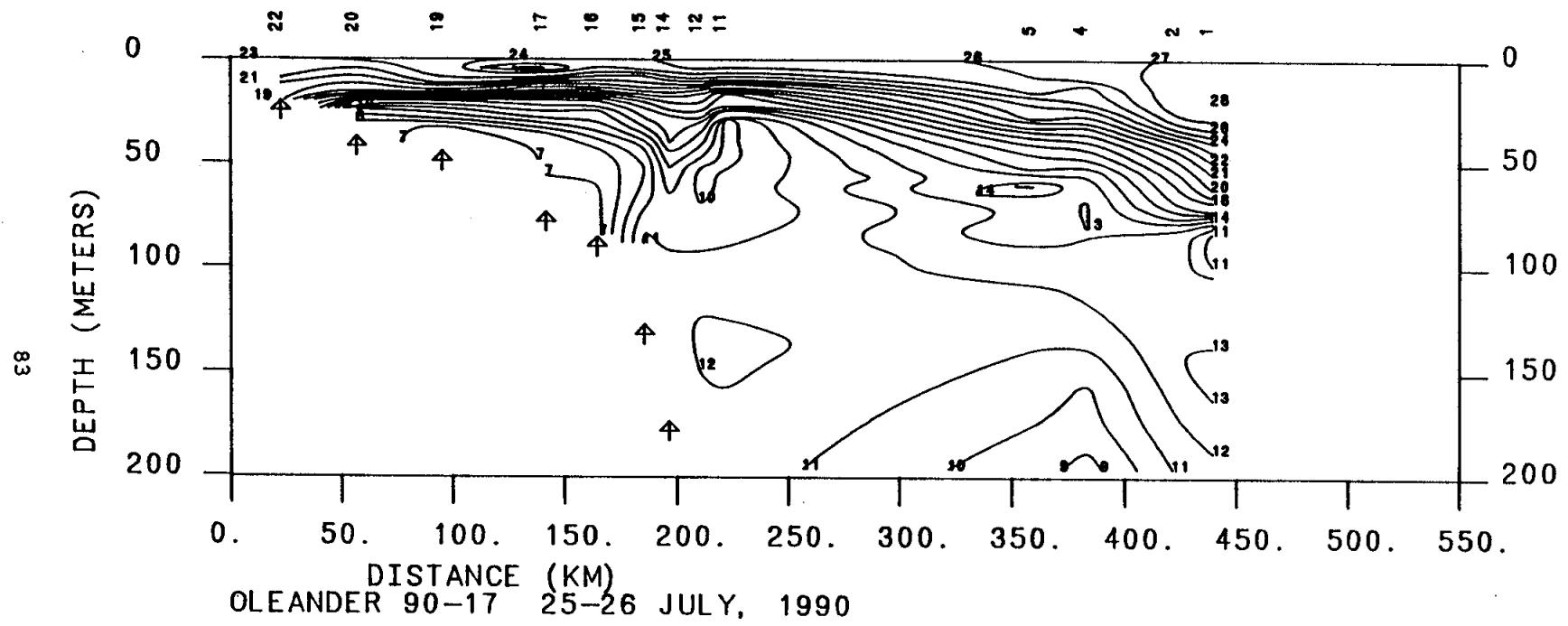


Figure 17(d). Contour plot of integer-valued isotherms to 200 m.

Figure 18. M/V *Oleander* Cruise 90-18

No data due to instrument malfunction

Figure 19. M/V *Oleander* Cruise 90-19, August 8-9, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m. of isotherms along the cruise track.
- d. Contour plot to 200 m. of isotherms along the cruise track.

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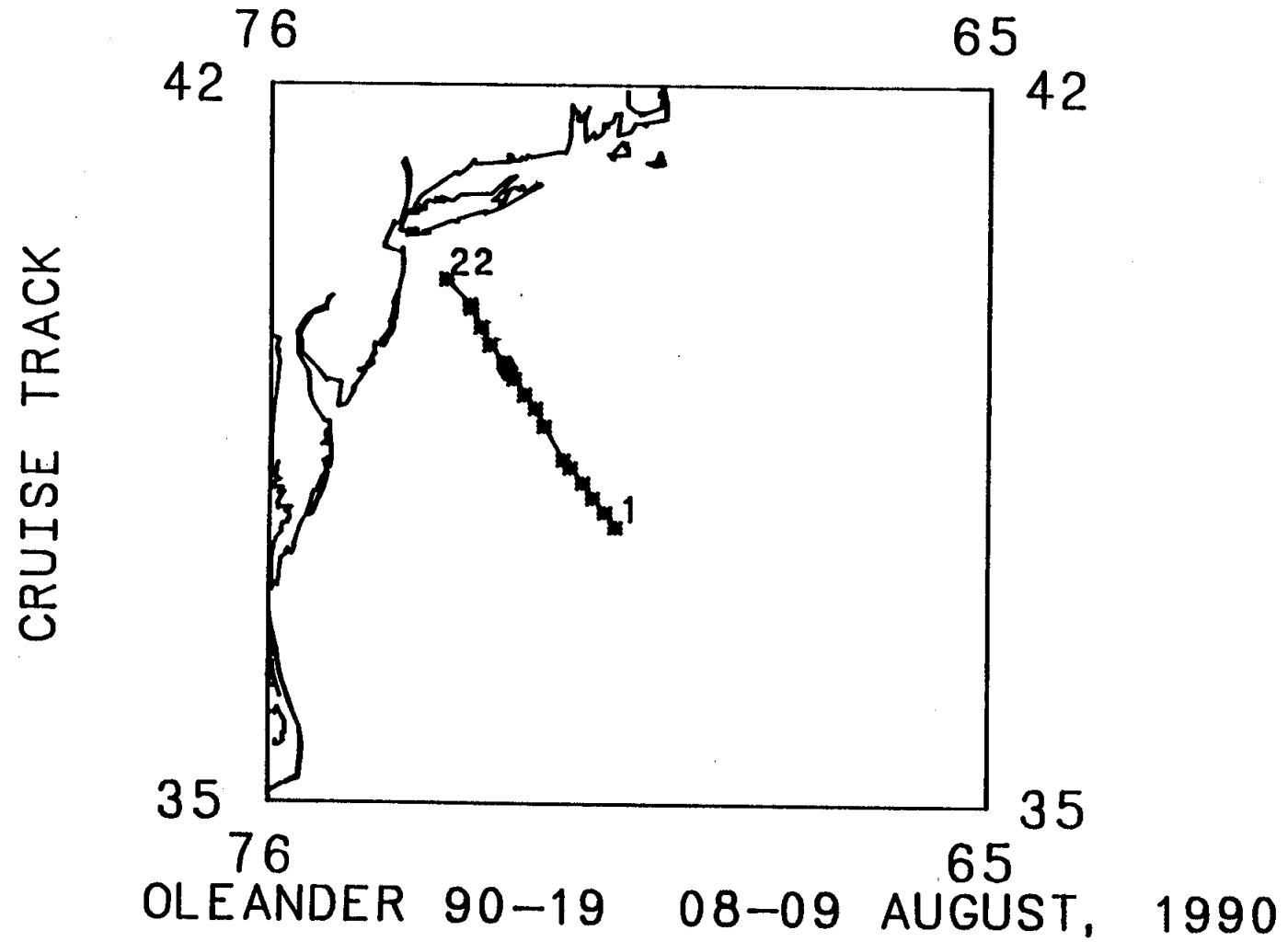


Figure 19(a). Cruise track and locations of XBT stations.

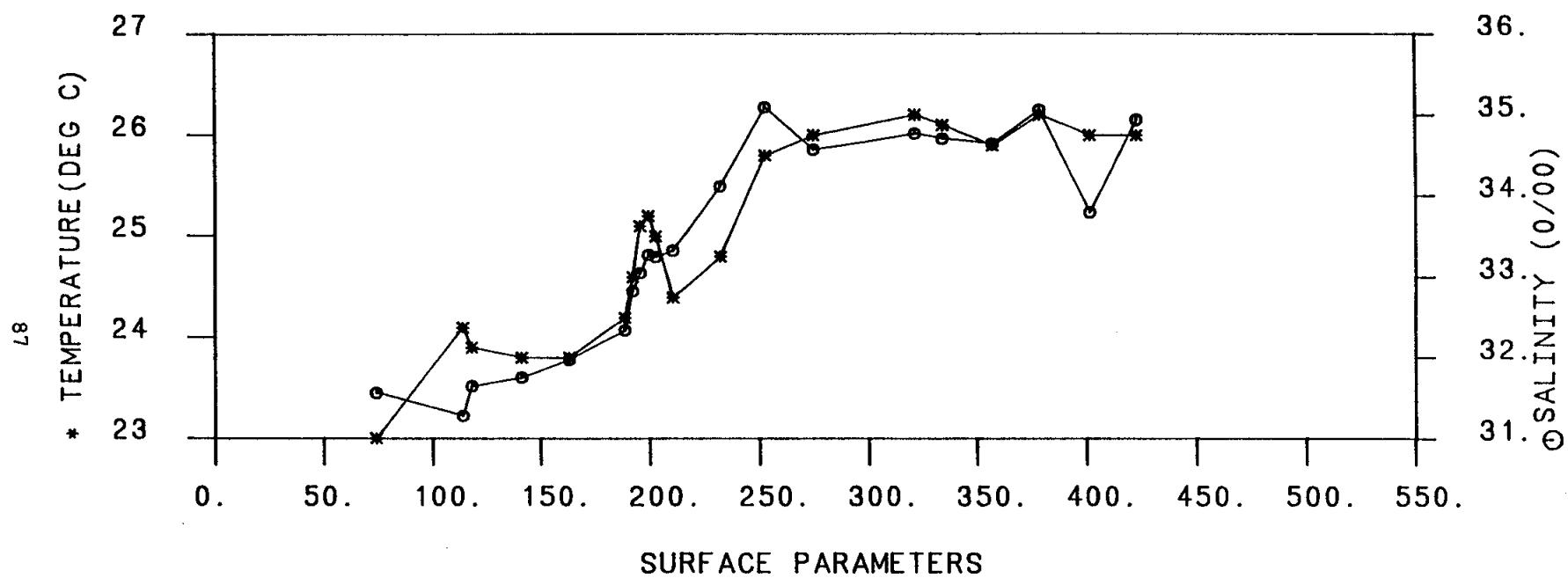


Figure 19(b). Surface temperature and salinity.

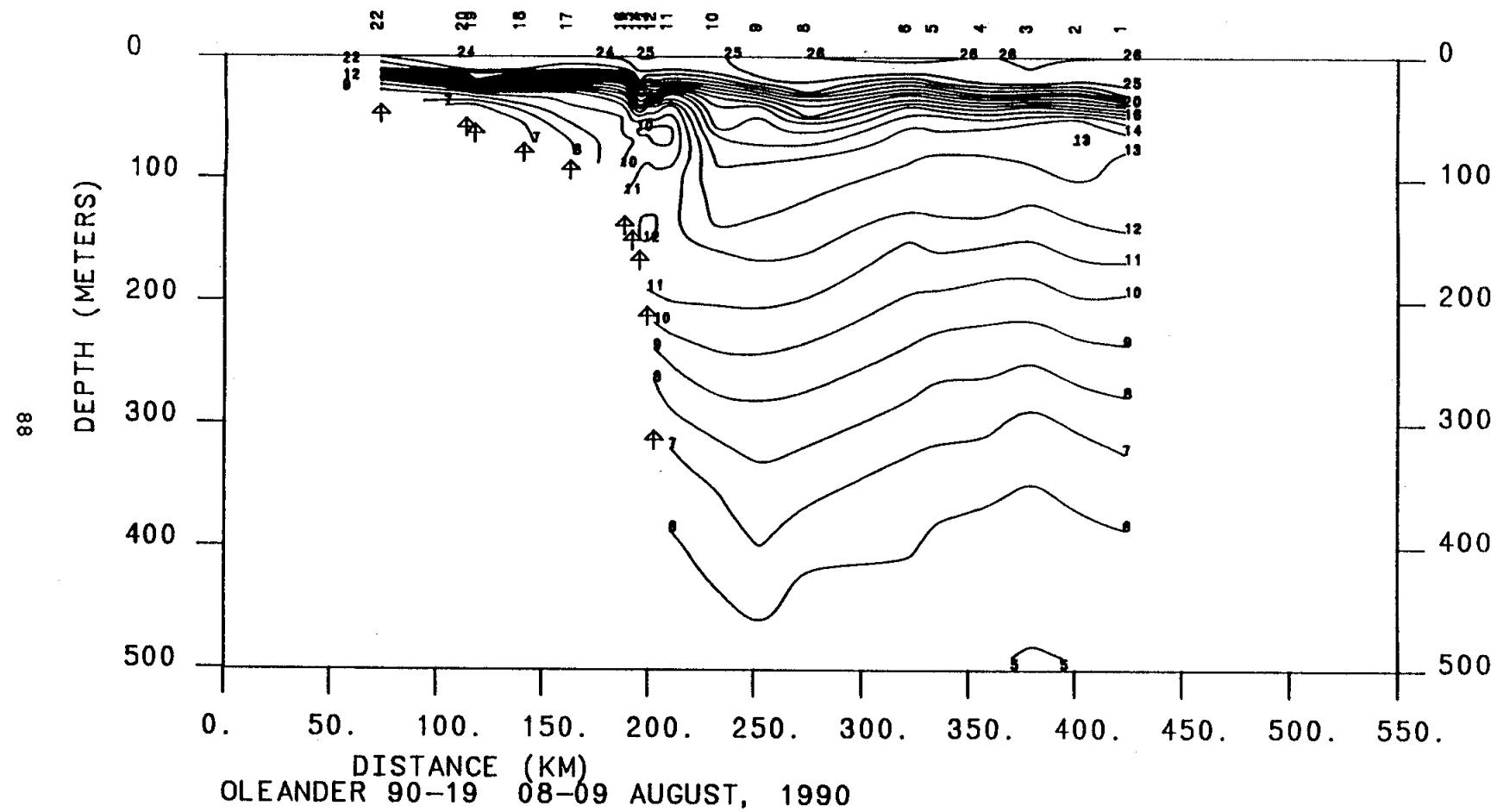


Figure 19(c). Contour plot of integer-valued isotherms to 500 m.

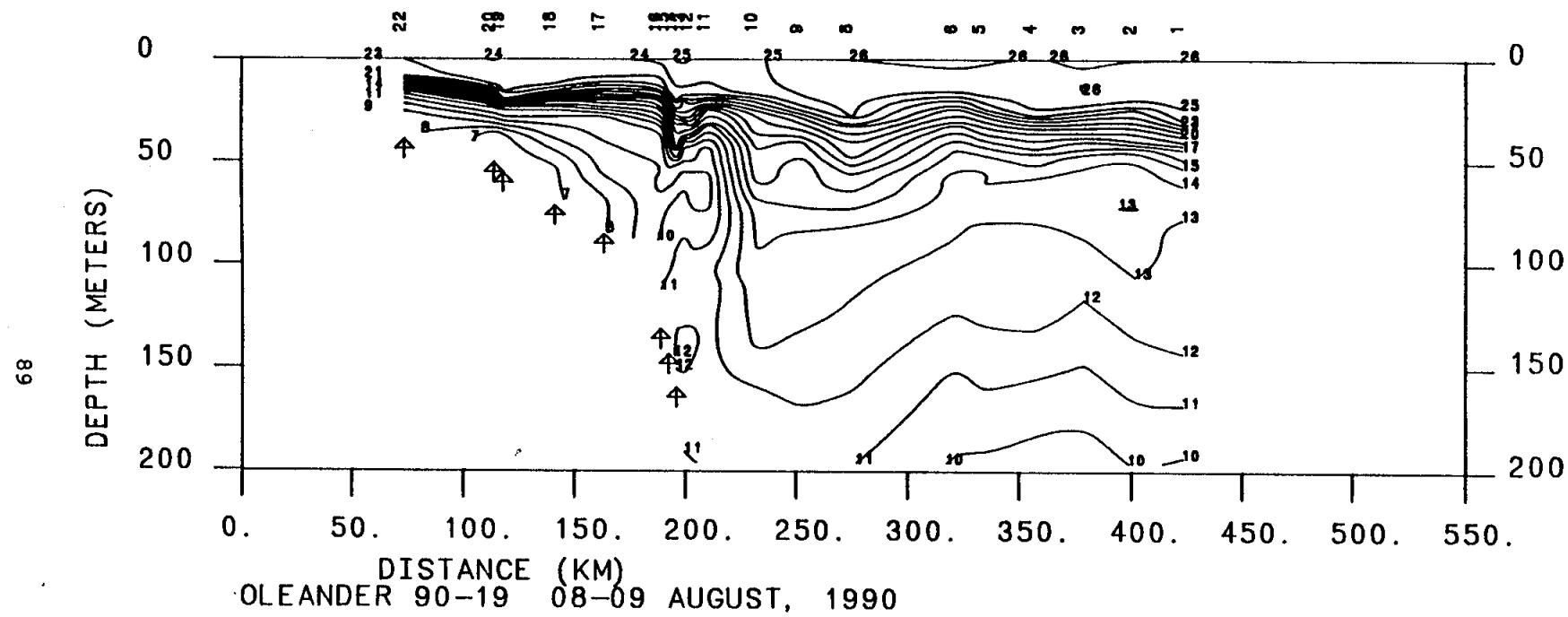


Figure 19(d). Contour plot of integer-valued isotherms to 200 m.

Figure 20. M/V *Oleander* Cruise 90-20, August 17, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m of isotherms along the cruise track.
- d. Contour plot to 200 m of isotherms along the cruise track.

T6

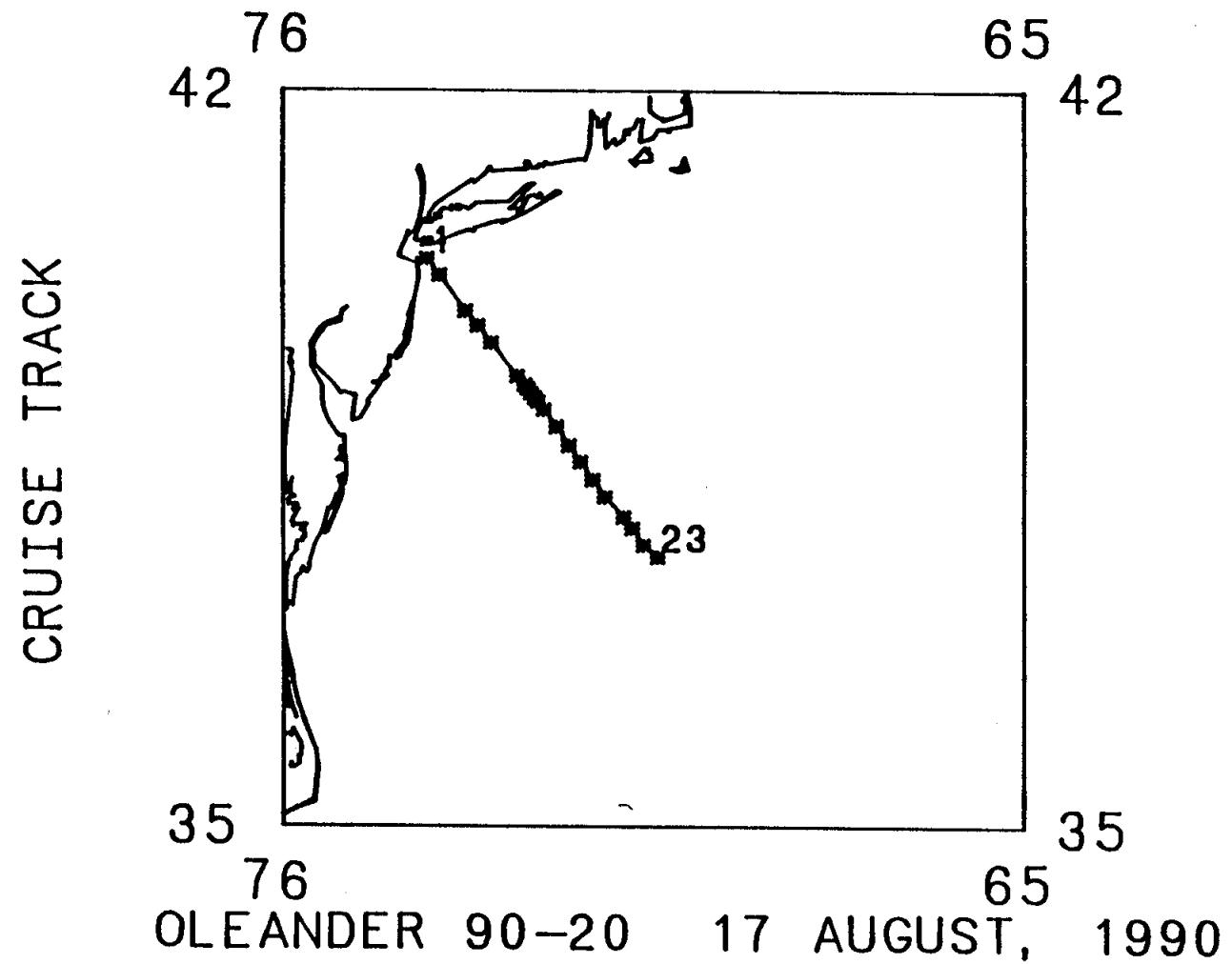


Figure 20(a). Cruise track and locations of XBT stations.

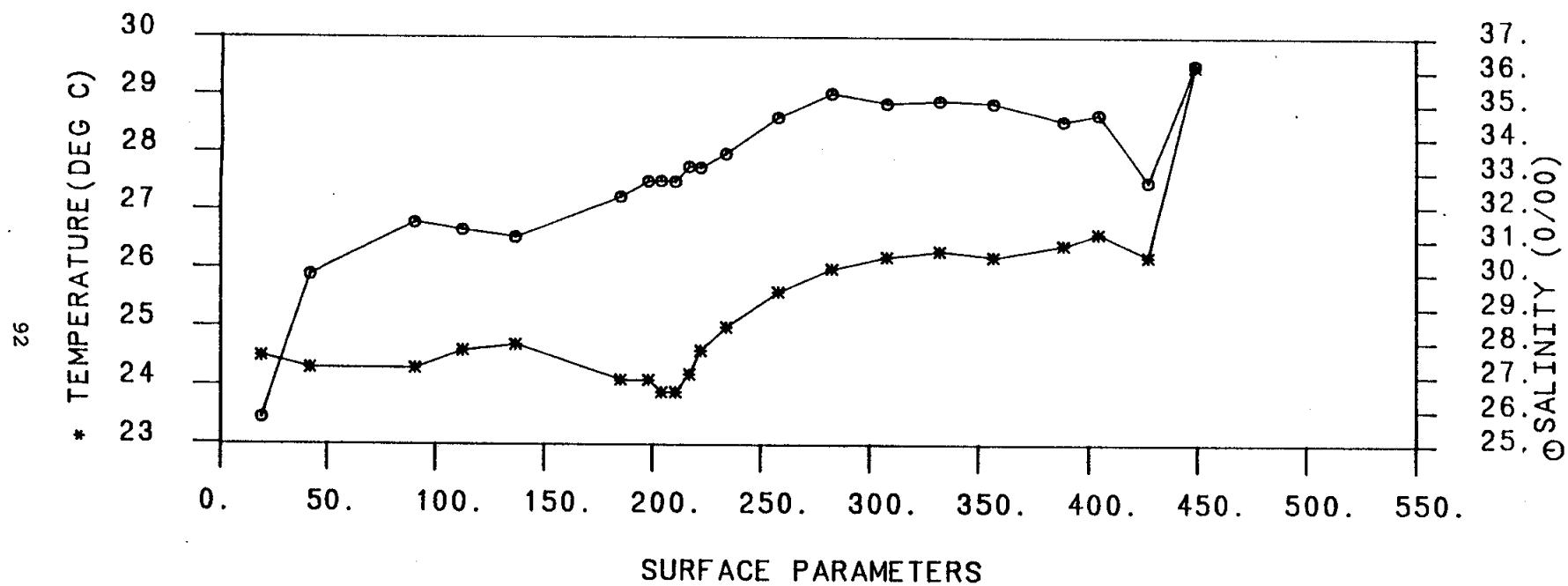


Figure 20(b). Surface temperature and salinity.

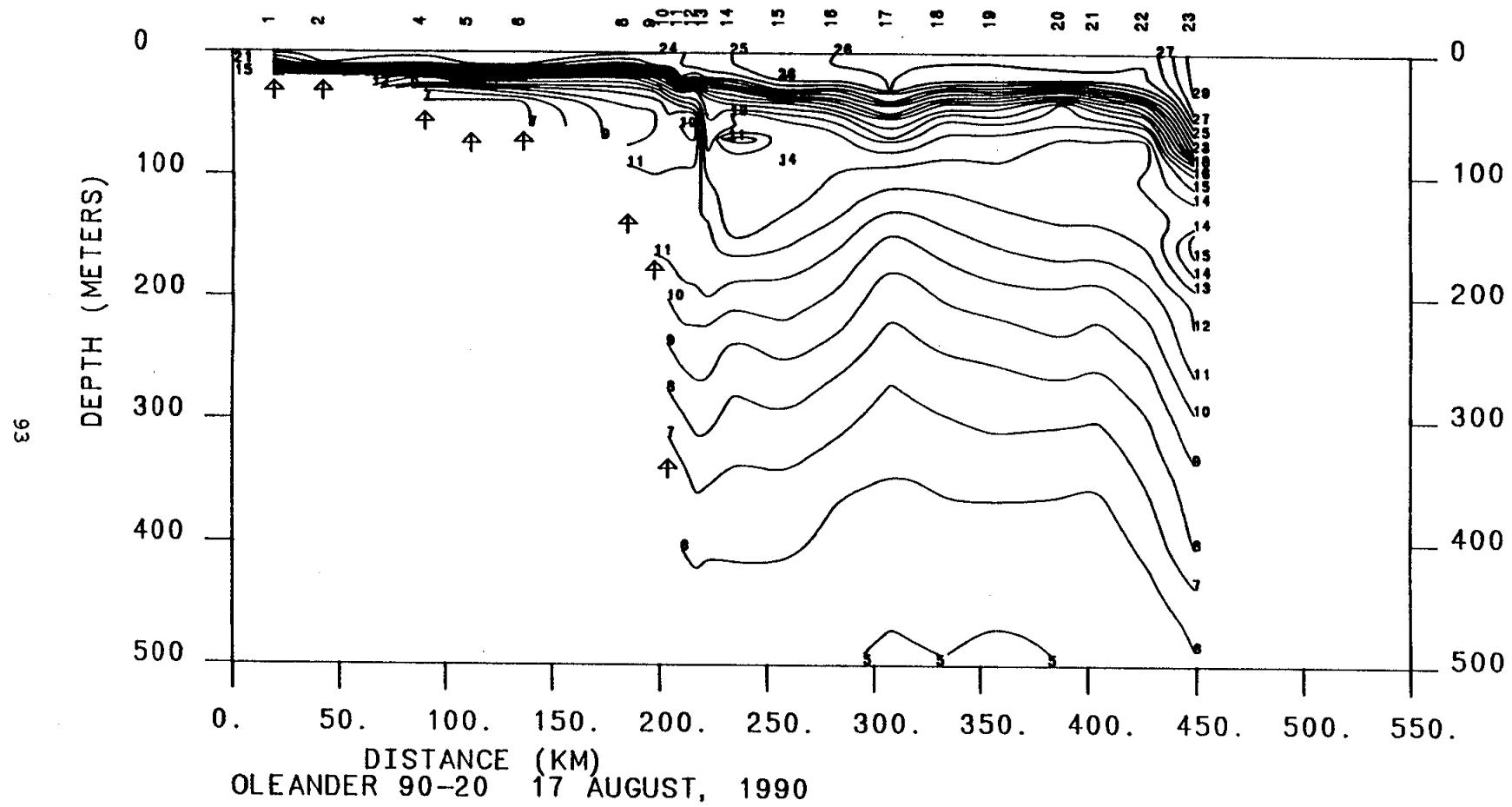


Figure 20(c). Contour plot of integer-valued isotherms to 500 m.

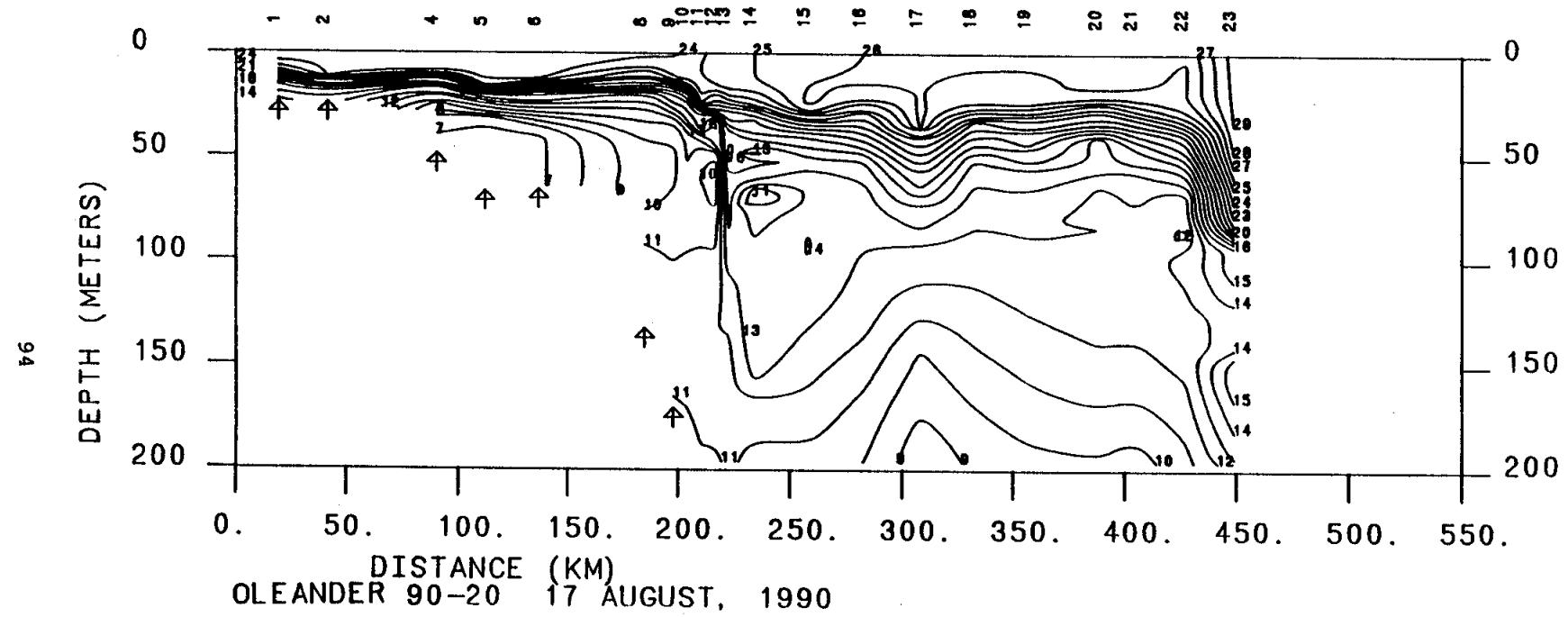


Figure 20(d). Contour plot of integer-valued isotherms to 200 m.

Figure 21. M/V *Oleander* Cruise 90-21, August 22-23, 1990

- a. Cruise track and locations of XBT stations.
- b. Surface temperature and salinity along the cruise track.
- c. Contour plot to 500 m. of isotherms along the cruise track.
- d. Contour plot to 200 m. of isotherms along the cruise track.

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CRUISE TRACK

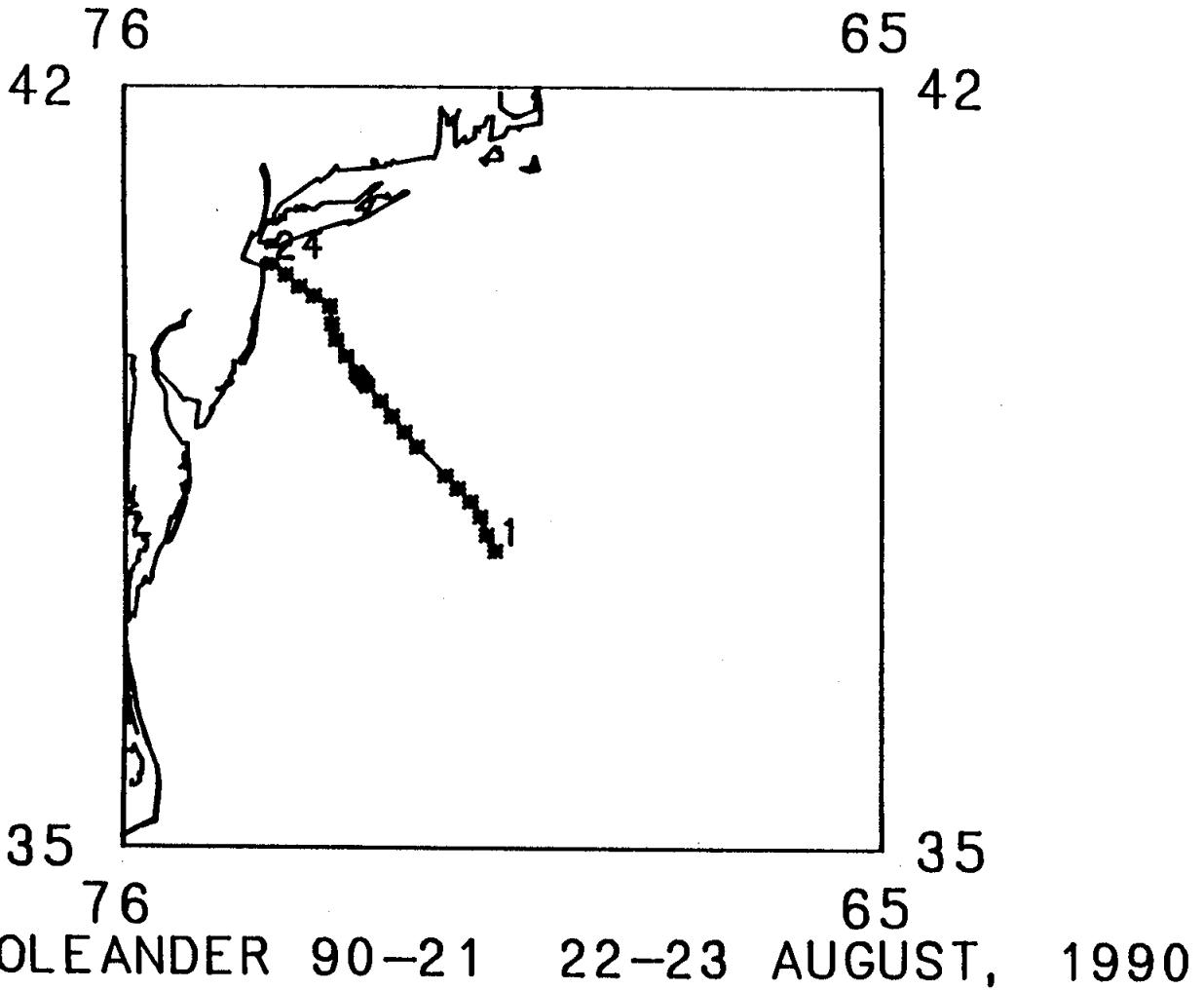


Figure 21(a). Cruise track and locations of XBT stations.

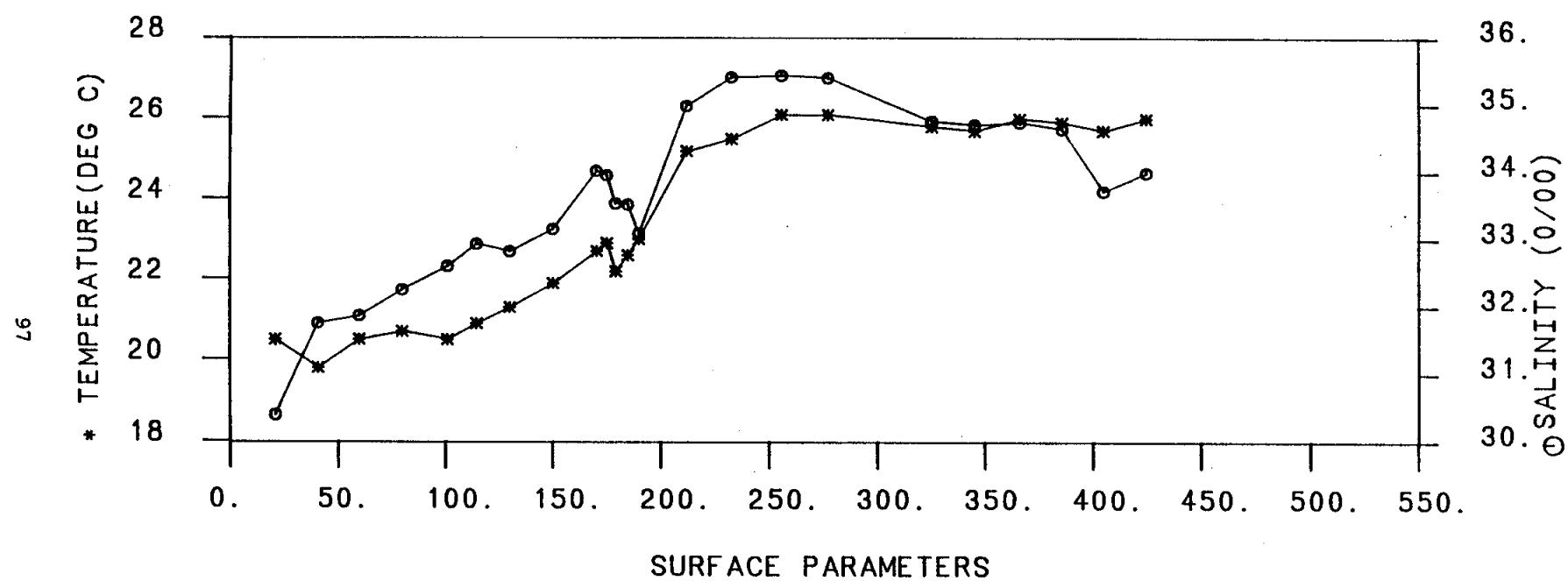


Figure 21(b). Surface temperature and salinity.

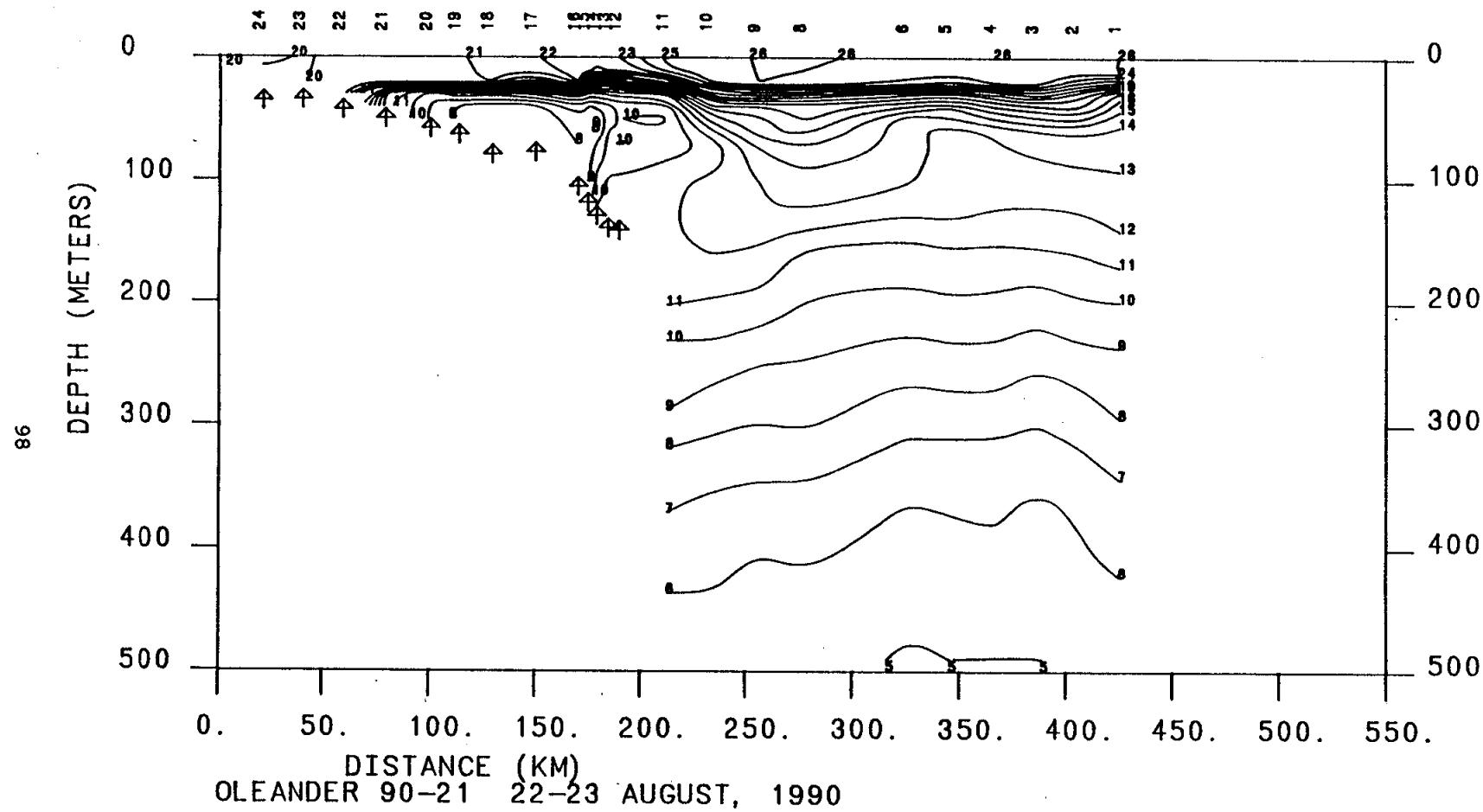


Figure 21(c). Contour plot of integer-valued isotherms to 500 m.

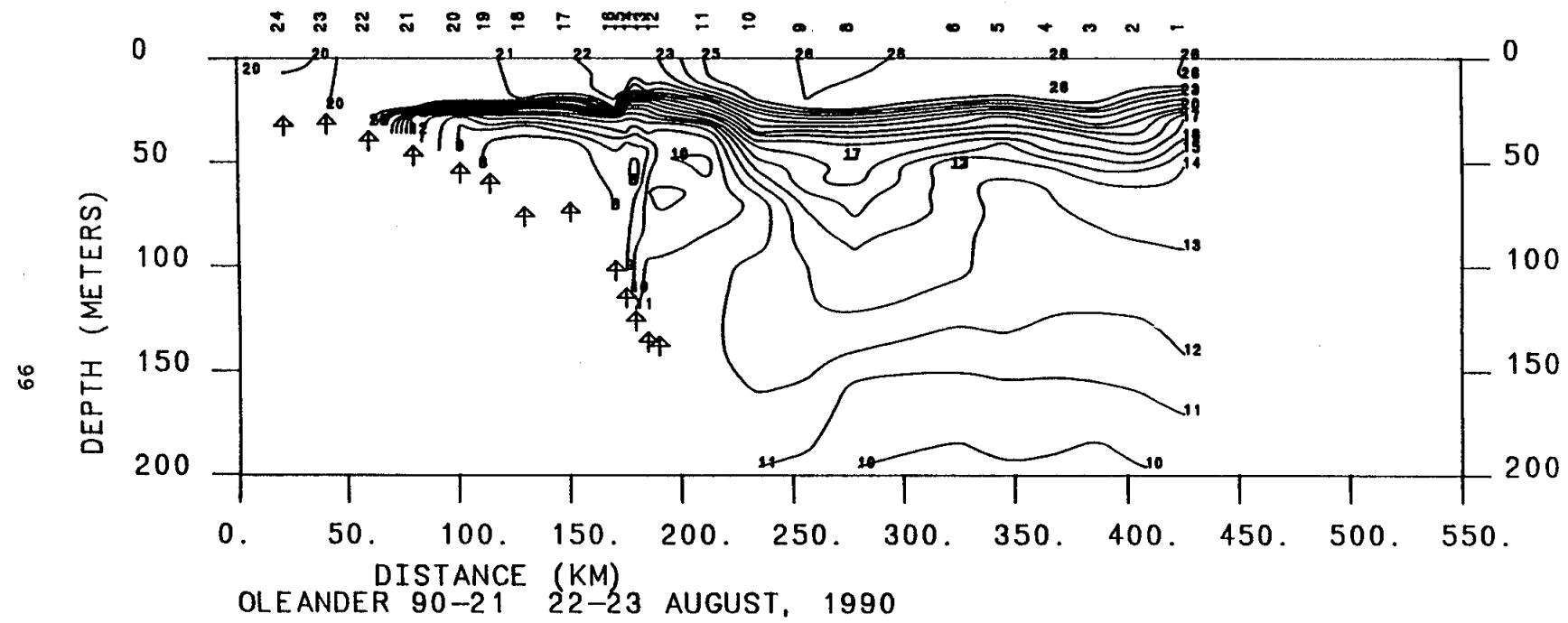


Figure 21(d). Contour plot of integer-valued isotherms to 200 m.



Appendix: Station Locations for M/V *Oleander* XBT Cruises

OLEANDER Cruise 9003

Station	Latitude	Longitude
1	40° 16.56' N	73° 32.28' W
2	40° 12.12' N	73° 24.42' W
3	40° 06.00' N	73° 16.44' W
4	40° 0.60' N	73° 09.36' W
5	39° 30.72' N	73° 03.00' W
6	39° 24.72' N	72° 31.14' W
7	39° 19.08' N	72° 24.00' W
8	39° 12.60' N	72° 17.10' W
9	39° 10.92' N	72° 14.76' W
10	39° 09.48' N	72° 13.32' W
11	39° 08.28' N	72° 12.00' W
12	39° 06.66' N	72° 10.14' W
13	39° 0.42' N	72° 03.66' W
14	38° 30.00' N	71° 32.70' W
15	38° 24.60' N	71° 25.80' W
16	38° 18.12' N	71° 18.90' W
17	38° 12.12' N	71° 10.80' W
18	38° 06.00' N	71° 04.92' W
19	38° 0.12' N	70° 33.00' W
20	37° 30.00' N	70° 23.58' W
21	37° 23.40' N	70° 15.00' W
22	37° 21.00' N	70° 12.00' W

OLEANDER Cruise 9004

Station	Latitude	Longitude
1	40° 16.56' N	73° 28.38' W
2	40° 15.00' N	73° 27.00' W
3	40° 08.40' N	73° 20.10' W
4	40° 01.80' N	73° 13.20' W
5	39° 33.30' N	73° 06.12' W
6	39° 22.02' N	72° 28.20' W
7	39° 16.38' N	72° 21.24' W
8	39° 10.56' N	72° 13.86' W
9	39° 09.60' N	72° 12.30' W
10	39° 08.10' N	72° 10.56' W
11	39° 06.72' N	72° 08.58' W
12	39° 04.98' N	72° 06.60' W
13	38° 35.40' N	72° 0.00' W
14	38° 30.00' N	71° 29.40' W
15	38° 25.80' N	71° 22.20' W
16	38° 17.76' N	71° 15.60' W
17	38° 13.98' N	71° 06.90' W
18	38° 07.80' N	71° 03.60' W
19	38° 02.10' N	70° 33.00' W
20	37° 33.00' N	70° 24.30' W
21	37° 28.20' N	70° 14.40' W
22	37° 27.60' N	70° 15.00' W

OLEANDER Cruise 9005

Station	Latitude	Longitude
1	40 ° 15.90 'N	73 ° 30.90 'W
2	40 ° 10.80 'N	73 ° 23.70 'W
3	40 ° 04.80 'N	73 ° 17.10 'W
4	39 ° 35.40 'N	73 ° 09.90 'W
5	39 ° 30.24 'N	73 ° 03.30 'W
6	39 ° 24.30 'N	72 ° 33.60 'W
7	39 ° 18.90 'N	72 ° 25.80 'W
8	39 ° 13.20 'N	72 ° 18.36 'W
9	39 ° 10.20 'N	72 ° 14.70 'W
10	39 ° 08.76 'N	72 ° 13.02 'W
11	39 ° 07.02 'N	72 ° 11.04 'W
12	39 ° 04.56 'N	72 ° 07.98 'W
13	39 ° 01.86 'N	72 ° 04.56 'W
14	38 ° 32.10 'N	71 ° 34.26 'W
15	38 ° 27.00 'N	71 ° 27.30 'W
16	38 ° 21.00 'N	71 ° 20.10 'W
17	38 ° 15.60 'N	71 ° 13.20 'W
18	38 ° 10.20 'N	71 ° 06.60 'W
19	38 ° 04.20 'N	71 ° 01.80 'W
20	37 ° 35.40 'N	70 ° 31.20 'W
21	37 ° 29.40 'N	70 ° 23.40 'W
22	37 ° 24.60 'N	70 ° 13.80 'W

OLEANDER Cruise 9006

Station	Latitude	Longitude
1	37 ° 17.10 'N	70 ° 27.00 'W
2	37 ° 23.10 'N	70 ° 32.10 'W
3	37 ° 29.10 'N	71 ° 01.80 'W
4	37 ° 35.70 'N	71 ° 07.80 'W
5	38 ° 04.80 'N	71 ° 13.20 'W
6	38 ° 10.20 'N	71 ° 17.40 'W
7	38 ° 15.60 'N	71 ° 22.80 'W
8	38 ° 22.20 'N	71 ° 27.00 'W
9	38 ° 28.20 'N	71 ° 32.40 'W
10	38 ° 33.30 'N	72 ° 00.00 'W
11	39 ° 02.64 'N	72 ° 06.30 'W
12	39 ° 07.80 'N	72 ° 10.80 'W
13	39 ° 10.80 'N	72 ° 13.20 'W
14	39 ° 11.10 'N	72 ° 13.26 'W
15	39 ° 12.06 'N	72 ° 14.28 'W
16	39 ° 13.02 'N	72 ° 15.60 'W
17	39 ° 18.30 'N	72 ° 21.66 'W
18	39 ° 23.40 'N	72 ° 27.00 'W
19	39 ° 28.50 'N	72 ° 32.70 'W
20	39 ° 33.00 'N	73 ° 01.50 'W
21	40 ° 0.90 'N	73 ° 04.80 'W
22	40 ° 04.32 'N	73 ° 08.70 'W
23	40 ° 07.68 'N	73 ° 12.90 'W
24	40 ° 10.14 'N	73 ° 18.78 'W

OLEANDER Cruise 9007

Station.	Latitude	Longitude
1	40° 15.60' N	73° 30.00' W
2	40° 09.60' N	73° 22.80' W
3	40° 04.50' N	73° 15.60' W
4	39° 34.80' N	73° 09.00' W
5	39° 29.10' N	73° 02.10' W
6	39° 23.10' N	72° 31.20' W
7	39° 17.40' N	72° 24.30' W
8	39° 11.52' N	72° 17.16' W
9	39° 09.96' N	72° 15.36' W
10	39° 08.70' N	72° 13.80' W
11	39° 07.32' N	72° 12.00' W
12	39° 05.88' N	72° 09.90' W
13	39° 03.30' N	72° 03.30' W
14	38° 31.20' N	71° 32.40' W
15	38° 23.34' N	71° 22.62' W
16	38° 19.80' N	71° 18.00' W
17	38° 14.10' N	71° 11.70' W
18	38° 09.30' N	71° 05.10' W
19	38° 03.60' N	70° 34.80' W
20	37° 34.20' N	70° 28.20' W
21	37° 27.60' N	70° 21.00' W
22	37° 21.60' N	70° 12.60' W

OLEANDER Cruise 9008

Station	Latitude	Longitude
1	37° 09.72' N	70° 16.80' W
2	37° 15.60' N	70° 21.60' W
3	37° 21.06' N	70° 25.20' W
4	37° 27.00' N	70° 28.50' W
5	37° 33.00' N	70° 32.40' W
6	38° 03.90' N	71° 02.70' W
7	38° 09.90' N	71° 09.00' W
8	38° 15.90' N	71° 15.60' W
9	38° 22.20' N	71° 22.50' W
10	38° 28.80' N	71° 30.00' W
11	38° 34.80' N	72° 01.80' W
12	39° 05.10' N	72° 08.70' W
13	39° 10.32' N	72° 13.62' W
14	39° 12.12' N	72° 15.30' W
15	39° 13.92' N	72° 17.10' W
16	39° 15.66' N	72° 18.60' W
17	39° 17.22' N	72° 19.92' W
18	39° 19.26' N	72° 21.84' W
19	39° 26.28' N	72° 28.74' W
20	39° 33.00' N	72° 35.40' W
21	40° 02.70' N	73° 06.90' W
22	40° 08.52' N	73° 15.30' W
23	40° 13.32' N	73° 24.24' W

OLEANDER Cruise 9009

Station	Latitude	Longitude
1	37° 14.40' N	70° 21.60' W
2	37° 21.00' N	70° 25.80' W
3	37° 26.40' N	70° 27.60' W
4	37° 33.60' N	70° 30.00' W
5	38° 03.60' N	71° 01.20' W
6	38° 07.80' N	71° 06.60' W
7	38° 12.00' N	71° 10.80' W
8	38° 17.40' N	71° 15.90' W
9	38° 26.10' N	71° 18.90' W
10	38° 30.00' N	71° 21.30' W
11	38° 34.20' N	71° 27.90' W
12	39° 02.40' N	71° 34.20' W
13	39° 06.00' N	72° 02.10' W
14	39° 09.00' N	72° 05.40' W
15	39° 10.50' N	72° 06.90' W
16	39° 11.40' N	72° 07.80' W
17	39° 13.80' N	72° 10.50' W
18	39° 19.80' N	72° 17.10' W
19	39° 25.20' N	72° 24.00' W
20	39° 30.30' N	72° 30.60' W
21	40° 01.80' N	73° 03.90' W
22	40° 05.10' N	73° 12.30' W
23	40° 09.48' N	73° 20.10' W
24	40° 12.30' N	73° 22.80' W

OLEANDER Cruise 9010

Station	Latitude	Longitude
1	40° 16.32' N	73° 32.10' W
2	40° 08.40' N	73° 20.58' W
3	40° 03.00' N	73° 13.50' W
4	39° 33.30' N	73° 06.90' W
5	39° 27.90' N	73° 0.00' W
6	39° 22.20' N	72° 29.10' W
7	39° 16.50' N	72° 21.90' W
8	39° 12.00' N	72° 16.20' W
9	39° 10.50' N	72° 14.70' W
10	39° 09.00' N	72° 12.90' W
11	39° 07.50' N	72° 11.10' W
12	39° 04.80' N	72° 07.80' W
13	38° 34.50' N	72° 0.60' W
14	38° 29.40' N	71° 29.10' W
15	38° 23.70' N	71° 22.20' W
16	38° 18.00' N	71° 15.00' W
17	38° 12.00' N	71° 08.40' W
18	38° 06.60' N	71° 01.20' W
19	38° 01.50' N	70° 30.60' W
20	37° 32.10' N	70° 22.80' W
21	37° 27.00' N	70° 15.00' W

OLEANDER Cruise 9011

Station	Latitude	Longitude
1	37° 09.00' N	70° 16.20' W
2	37° 15.00' N	70° 20.10' W
3	37° 20.40' N	70° 25.50' W
4	37° 24.60' N	70° 30.60' W
5	37° 29.70' N	71° 06.00' W
6	37° 35.40' N	71° 07.20' W
7	38° 04.20' N	71° 13.80' W
8	38° 09.00' N	71° 20.70' W
9	38° 14.70' N	71° 27.00' W
10	38° 20.70' N	71° 33.90' W
11	38° 26.70' N	72° 03.90' W
12	38° 33.60' N	72° 09.90' W
13	39° 04.50' N	72° 15.60' W
14	39° 06.60' N	72° 17.10' W
15	39° 09.60' N	72° 19.20' W
16	39° 11.10' N	72° 20.40' W
17	39° 17.70' N	72° 24.90' W
18	39° 23.70' N	72° 29.70' W
19	39° 29.70' N	72° 33.60' W
20	39° 35.70' N	73° 03.90' W
21	40° 04.20' N	73° 08.40' W
22	40° 08.40' N	73° 15.00' W
23	40° 11.40' N	73° 20.70' W
24	40° 14.10' N	73° 25.50' W
25	40° 16.20' N	73° 29.70' W

OLEANDER Cruise 9012

Station	Latitude	Longitude
1	40° 15.60' N	73° 29.10' W
2	40° 10.20' N	73° 22.20' W
3	40° 04.20' N	73° 15.00' W
4	39° 35.40' N	73° 07.20' W
5	39° 30.00' N	73° 03.30' W
6	39° 24.30' N	72° 29.40' W
7	39° 18.90' N	72° 23.10' W
8	39° 12.90' N	72° 16.20' W
9	39° 11.40' N	72° 14.40' W
10	39° 09.90' N	72° 12.60' W
11	39° 09.30' N	72° 11.40' W
12	39° 07.20' N	72° 09.30' W
13	39° 01.80' N	72° 03.00' W
14	38° 32.70' N	71° 32.40' W
15	38° 27.60' N	71° 24.60' W
16	38° 22.20' N	71° 18.00' W
17	38° 16.80' N	71° 10.80' W
18	38° 11.40' N	71° 04.50' W
19	38° 06.30' N	70° 33.60' W
20	38° 01.20' N	70° 26.40' W
21	37° 31.20' N	70° 19.80' W
22	37° 25.80' N	70° 13.20' W
23	37° 22.20' N	70° 04.80' W
24	37° 18.00' N	69° 31.20' W

OLEANDER Cruise 9013

Station	Latitude	Longitude
1	37° 22.20' N	70° 16.80' W
2	37° 27.00' N	70° 22.20' W
3	37° 31.80' N	70° 28.80' W
4	38° 01.20' N	70° 34.80' W
5	38° 06.00' N	71° 04.20' W
6	38° 11.40' N	71° 10.20' W
7	38° 16.20' N	71° 16.20' W
8	38° 21.60' N	71° 21.60' W
9	38° 26.70' N	71° 27.00' W
10	38° 33.00' N	71° 31.20' W
11	39° 02.10' N	72° 03.30' W
12	39° 07.50' N	72° 05.10' W
13	39° 13.20' N	72° 09.90' W
14	39° 13.80' N	72° 11.70' W
15	39° 15.00' N	72° 12.60' W
16	39° 15.60' N	72° 13.20' W
17	39° 16.50' N	72° 14.10' W
18	39° 21.60' N	72° 20.40' W
19	39° 27.00' N	72° 26.70' W
20	39° 32.70' N	72° 33.00' W
21	40° 02.70' N	73° 01.80' W
22	40° 07.80' N	73° 10.80' W
23	40° 11.10' N	73° 18.60' W
24	40° 14.40' N	73° 25.80' W
25	40° 16.80' N	73° 30.90' W

OLEANDER Cruise 9014

Station	Latitude	Longitude
1	40° 16.92' N	73° 31.68' W
2	40° 11.58' N	73° 24.18' W
3	40° 05.40' N	73° 16.50' W
4	40° 0.00' N	73° 09.60' W
5	39° 30.60' N	73° 03.30' W
6	39° 25.20' N	72° 33.30' W
7	39° 19.80' N	72° 26.40' W
8	39° 13.80' N	72° 19.80' W
9	39° 12.00' N	72° 16.50' W
10	39° 10.50' N	72° 14.70' W
11	39° 09.00' N	72° 13.20' W
12	39° 07.80' N	72° 11.40' W
13	39° 06.30' N	72° 09.30' W
14	39° 03.60' N	72° 06.60' W
15	38° 34.26' N	71° 35.40' W
16	38° 28.86' N	71° 29.40' W
17	38° 23.10' N	71° 22.68' W
18	38° 17.94' N	71° 16.62' W
19	38° 12.00' N	71° 10.50' W
20	38° 06.00' N	71° 04.20' W
21	38° 0.60' N	70° 35.40' W
22	37° 30.60' N	70° 29.40' W
23	37° 24.90' N	70° 23.40' W

OLEANDER Cruise 9015

Station	Latitude	Longitude
1	37° 22.20' N	70° 12.00' W
2	37° 28.20' N	70° 15.60' W
3	37° 33.60' N	70° 21.00' W
4	38° 03.00' N	70° 27.00' W
5	38° 07.92' N	70° 33.00' W
6	38° 12.60' N	71° 03.30' W
7	38° 17.94' N	71° 09.72' W
8	38° 22.86' N	71° 15.72' W
9	38° 27.90' N	71° 22.80' W
10	38° 32.70' N	71° 30.00' W
11	39° 01.20' N	72° 0.90' W
12	39° 06.00' N	72° 05.70' W
13	39° 08.40' N	72° 08.10' W
14	39° 10.50' N	72° 10.20' W
15	39° 14.40' N	72° 15.00' W
16	39° 18.60' N	72° 20.10' W
17	39° 22.50' N	72° 24.00' W
18	39° 26.64' N	72° 28.44' W
19	39° 30.06' N	72° 32.46' W
20	39° 33.48' N	73° 0.30' W
21	40° 0.90' N	73° 04.68' W
22	40° 04.50' N	73° 08.10' W
23	40° 07.20' N	73° 13.20' W
24	40° 09.90' N	73° 18.60' W
25	40° 12.90' N	73° 24.00' W

OLEANDER Cruise 9016

Station	Latitude	Longitude
1	40° 16.44' N	73° 31.44' W
2	40° 09.90' N	73° 22.20' W
3	40° 04.50' N	73° 15.36' W
4	39° 34.80' N	73° 09.00' W
5	39° 28.86' N	73° 02.16' W
6	39° 23.28' N	72° 30.30' W
7	39° 17.28' N	72° 23.10' W
8	39° 12.90' N	72° 18.30' W
9	39° 11.40' N	72° 15.90' W
10	39° 09.90' N	72° 14.10' W
11	39° 08.28' N	72° 12.30' W
12	39° 07.08' N	72° 11.04' W
13	39° 05.76' N	72° 09.24' W
14	39° 0.60' N	72° 02.28' W
15	38° 31.08' N	71° 30.48' W
16	38° 24.60' N	71° 24.72' W
17	38° 18.72' N	71° 18.00' W
18	38° 13.20' N	71° 10.20' W
19	38° 07.50' N	71° 03.60' W
20	38° 02.40' N	70° 32.40' W
21	37° 32.40' N	70° 25.80' W
22	37° 27.00' N	70° 18.90' W
23	37° 22.50' N	70° 10.80' W

OLEANDER Cruise 9017

Station	Latitude	Longitude
1	37° 27.00 ' N	70° 16.20 ' W
2	37° 31.20 ' N	70° 19.80 ' W
3	38° 01.20 ' N	70° 24.60 ' W
4	38° 06.00 ' N	70° 30.00 ' W
5	38° 10.80 ' N	71° 01.20 ' W
6	38° 16.20 ' N	71° 08.70 ' W
7	38° 20.70 ' N	71° 13.80 ' W
8	38° 30.00 ' N	71° 22.20 ' W
9	38° 32.40 ' N	71° 29.34 ' W
10	39° 0.60 ' N	71° 35.40 ' W
11	39° 05.40 ' N	72° 06.12 ' W
12	39° 08.40 ' N	72° 08.70 ' W
13	39° 09.60 ' N	72° 09.60 ' W
14	39° 12.00 ' N	72° 12.60 ' W
15	39° 14.40 ' N	72° 15.90 ' W
16	39° 19.50 ' N	72° 21.90 ' W
17	39° 24.90 ' N	72° 28.38 ' W
18	39° 30.96 ' N	72° 34.50 ' W
19	40° 0.60 ' N	73° 04.80 ' W
20	40° 06.72 ' N	73° 19.92 ' W
21	40° 11.28 ' N	73° 21.36 ' W
22	40° 15.54 ' N	73° 29.10 ' W

OLEANDER Cruise 9018

Station	Latitude	Longitude
1	40° 16.08 ' N	73° 30.84 ' W
2	40° 12.36 ' N	73° 24.66 ' W
3	40° 06.84 ' N	73° 18.60 ' W
4	40° 01.08 ' N	73° 12.12 ' W
5	39° 31.38 ' N	73° 05.10 ' W
6	39° 25.50 ' N	72° 34.08 ' W
7	39° 19.68 ' N	72° 27.00 ' W
8	39° 14.10 ' N	72° 19.56 ' W
9	39° 12.30 ' N	72° 17.70 ' W
10	39° 11.10 ' N	72° 15.90 ' W
11	39° 08.10 ' N	72° 12.90 ' W
12	39° 06.60 ' N	72° 10.80 ' W
13	39° 02.70 ' N	72° 06.00 ' W
14	38° 33.00 ' N	71° 34.80 ' W
15	38° 27.00 ' N	71° 28.20 ' W
16	38° 20.64 ' N	71° 20.52 ' W
17	38° 13.08 ' N	71° 15.00 ' W
18	38° 06.60 ' N	71° 07.80 ' W
19	38° 0.12 ' N	71° 01.80 ' W
20	37° 34.20 ' N	70° 31.50 ' W
21	37° 28.80 ' N	70° 25.20 ' W
22	37° 23.70 ' N	70° 18.00 ' W
23	37° 19.20 ' N	70° 10.80 ' W

OLEANDER Cruise 9019

Station	Latitude	Longitude
1	37° 28.14' N	70° 24.48' W
2	37° 33.18' N	70° 30.54' W
3	38° 02.22' N	71° 01.62' W
4	38° 07.68' N	71° 07.20' W
5	38° 12.78' N	71° 14.10' W
6	38° 15.60' N	71° 18.00' W
7	38° 23.40' N	71° 27.00' W
8	38° 27.30' N	71° 28.80' W
9	38° 33.60' N	71° 33.90' W
10	39° 02.40' N	72° 03.90' W
11	39° 07.80' N	72° 09.60' W
12	39° 09.72' N	72° 11.82' W
13	39° 10.62' N	72° 12.60' W
14	39° 11.58' N	72° 13.56' W
15	39° 12.48' N	72° 14.46' W
16	39° 13.44' N	72° 15.36' W
17	39° 19.50' N	72° 22.80' W
18	39° 25.50' N	72° 27.90' W
19	39° 31.80' N	72° 33.60' W
20	39° 33.30' N	72° 34.20' W
21	40° 02.40' N	73° 04.20' W
22	40° 06.00' N	73° 10.92' W
23	40° 10.80' N	73° 20.40' W
24	40° 15.00' N	73° 26.40' W

OLEANDER Cruise 9020

Station	Latitude	Longitude
1	40° 16.50' N	73° 30.00' W
2	40° 11.10' N	73° 23.40' W
3	40° 05.22' N	73° 16.74' W
4	39° 35.22' N	73° 09.72' W
5	39° 30.24' N	73° 03.00' W
6	39° 24.48' N	72° 31.92' W
7	39° 18.66' N	72° 24.60' W
8	39° 13.08' N	72° 18.00' W
9	39° 10.20' N	72° 14.10' W
10	39° 08.82' N	72° 12.30' W
11	39° 07.26' N	72° 10.56' W
12	39° 05.70' N	72° 08.70' W
13	39° 04.44' N	72° 07.20' W
14	39° 01.80' N	72° 03.60' W
15	38° 32.10' N	71° 32.70' W
16	38° 25.80' N	71° 26.10' W
17	38° 20.40' N	71° 19.80' W
18	38° 14.40' N	71° 13.20' W
19	38° 08.40' N	71° 06.60' W
20	38° 01.50' N	70° 32.70' W
21	37° 33.60' N	70° 28.32' W
22	37° 27.90' N	70° 22.20' W
23	37° 23.82' N	70° 14.70' W

OLEANDER Cruise 9021

Station	Latitude	Longitude
1	37° 29.40' N	70° 21.60' W
2	37° 34.80' N	70° 26.28' W
3	38° 04.80' N	70° 29.70' W
4	38° 09.90' N	70° 34.80' W
5	38° 14.40' N	71° 05.40' W
6	38° 18.60' N	71° 11.70' W
7	38° 23.40' N	71° 18.90' W
8	38° 27.90' N	71° 26.40' W
9	38° 32.70' N	71° 33.00' W
10	39° 02.10' N	72° 03.60' W
11	39° 06.96' N	72° 09.72' W
12	39° 12.00' N	72° 16.50' W
13	39° 13.20' N	72° 18.00' W
14	39° 14.52' N	72° 19.56' W
15	39° 15.30' N	72° 21.00' W
16	39° 16.50' N	72° 22.20' W
17	39° 21.72' N	72° 27.60' W
18	39° 27.12' N	72° 32.70' W
19	39° 32.40' N	72° 35.10' W
20	40° 02.10' N	73° 00.00' W
21	40° 05.34' N	73° 08.22' W
22	40° 08.46' N	73° 15.96' W
23	40° 12.06' N	73° 22.80' W
24	40° 15.60' N	73° 30.00' W

